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EDITORIALS

Controlling Production in Railroad Shops

The problems of management in railroad shops are quite different from those of most other industries. In the average manufacturing plant, the production of the product is an end in itself. In railroad shops the repair of locomotives and cars is an important, but yet an incidental, part in the production of transportation. The output of the shops is necessarily subordinated to operating requirements and the result is often very unfavorable. There is scarcely a day when there is not some emergency work requiring the attention of the shop executives. These constant disruptions of plans for handling work are probably the most serious handicaps to the introduction of a well-planned system of railroad shop management.

It is apparent that the management of a railroad shop is in many ways more difficult than the management of an industrial plant, which in general operates under fairly uniform conditions, yet in spite of this fact, practically every railroad shop officer has to depend on his own resources in organizing the operations of the shop. There is no one to whom he can delegate the work of making a systematic analysis of conditions and means of improving them. It would seem that one of the prime needs in many shops is some method of obtaining definite information on which to base recommendations for changes in methods. At every large shop, at least, there should be a man to check up the processes of the shop and devise new methods of cutting costs. He would find a wide field of usefulness and, with the proper co-operation, would no doubt be able to reduce the waste that now exists because of lack of systematic analysis of costs. Among the subjects to which he might give attention are the routing of work; the improvement or replacement of obsolete tools; methods for quantity production by the use of jigs and fixtures; the regulation of speeds and feeds of machine tools; methods of handling material about the shops and labor turnover. These are items which shop officers cannot give sufficient attention and their neglect is responsible for a great deal of waste and inefficiency.

Boiler Plant Efficiency

Some pertinent test data and conclusions regarding actual and ideal boiler plant efficiency are included in an article in this issue. As a rule, the power plants which furnish power, heat and light for railroad shops and engine terminals receive little attention by higher officers as long as they function without interruption. It is true that taken in the aggregate, however, they represent an immense investment with great possibilities either in the way of inefficient and costly, or efficient and economical operation. The difference between these two conditions may be represented by the difference between boiler efficiencies of 45.3 and 78.1 per cent, or in an ideal case 90 per cent. It would not be difficult to get a comparatively close estimate of the number of thousand tons of coal utilized in railway power plants and figure out what this difference in boiler efficiency means in dollars and cents.

It is undoubtedly true that many existing railway boiler installations can be improved in efficiency at a comparatively slight cost, either by the adoption of means to reduce excess air to the required amount, eliminate excessive flue gas temperature, insure complete combustion, or reduce the carbon loss in ash. The features of an ideal boiler installation are summarized in the last part of the article and it is suggested that by comparing actual conditions with those necessary for the most efficient boiler operation, power plant engineers can ascertain the changes which in any individual case are needed to produce important savings.

There is an awakening appreciation on the part of railroad men of the possibilities of economy in power plant operation and this fact is demonstrated in the replies to a questionnaire recently sent out to leading railroads. These replies showed that in many cases railroads are not only planning improved methods but are to purchase new power plant equipment, including boilers, automatic stokers, economizers, modern air compressors and other improved power plant machinery. The watchwords adopted by American industry for 1922 are—Eliminate Waste, Increase Efficiency and Stimulate Production—and it is to be hoped that this program will be adopted and carried out in all departments of railroads, including the mechanical department which is responsible for back shop, engine terminal and power plant operation.

Look After Air Leak Losses

The day when compressed air was looked upon mainly as a convenience, and when the requirements of the ordinary railroad shop or roundhouse could be supplied by one or more second-hand air-brake pumps, when the air mains were of small size pipe extended indefinitely, has long since passed. Today compressed air is so vitally essential to the economical operation of a railroad shop, no matter what the size, that it is common to find a central station well equipped with suitable motor or steam driven air compressors. The modern shop has a well laid out and conveniently located system of air mains of a size suitable to eliminate excessive losses due to air friction.

The importance of an adequate supply of compressed air is well recognized and if the compressors are of a sufficient capacity to meet the demands it is all too often assumed that conditions are satisfactory. Leakage may, however, be forcing the compression of a much larger amount of air than is used for the actual work done. Inasmuch as the leakage of compressed air, unlike steam or water, is invisible, the magnitude or even the existence of such losses is often unrecognized. The expense resultant from a small but continuous drain on the air supply will in a short time run up to a sum, the extent of which all too few realize.

One of the best checks, and one which should be applied at regular intervals, is to pump up the air to full pressure with all air tools or machines shut down, and then note the number of strokes being made by the compressor, and then shut down the compressor and note the rate at which the air pressure falls. From the size of the compressor or from the capacity of the air reservoirs and mains an approximation of the leakage losses can be calculated and an estimate made of the cost of such losses. This test usually will have to be made at night or some time when the consumption of air can be entirely, or at least nearly suspended. How many, we wonder, would care to give out the results of such a test?

Part of the leakage is usually traceable to leaks at pipe

joints or at gaskets and can be detected by a systematic application of the well-known soap suds test. Much of the loss is also in many instances caused by leaky stop cocks or valves. Another large source of waste of a different character occurs where an air nozzle is used for blowing out or cleaning purposes. The orifice is frequently larger than necessary and the air consumption is correspondingly increased. Then again the air may be used for a larger period than necessary. To reduce air consumption the valve used in connection with a blowing nozzle invariably should be of the self-closing type that will not remain open longer than it is held open by the operator.

Systematic tests and regular inspections for leakage are of as much importance in connection with the shop compressed air system as in connection with the air brake piping system of cars and locomotives. If properly attended to, and mains, cocks and air tools kept in good working condition, the resultant saving will repay all effort and expense involved.

The New National Working Rules

IT would probably be difficult to enumerate all of the causes which led to the complete loss of morale suffered by railway shop organizations during the war. But it may be stated with assurance that the sudden and amazing dissolution of the bonds of discipline was very largely brought about by the policies of the United States Railroad Administration. While listening with a sympathetic ear to every plea from the ranks, the impression was allowed to grow unchallenged that all officers charged with responsibility were of evil origin and intent. Hence it seemingly became a matter of high moral duty to circumvent these creatures of the devil in the exercise of their authority. If any doubts were ever felt as to the orthodoxy of this attitude they were finally set at rest by the terms of the national agreement which, with the interpretation thereto, developed into a cunningly devised labyrinth of obstructions wherein to entangle and hinder the supervisory forces in the pursuit of their purposes. The punitive and restrictive features of the old national agreements, bad as they were in their direct effect, were indirectly even more vicious in the stamp of approval which they seemed to place on the practice of insubordination and peaceful sabotage.

In their case before the Labor Board the railroads pled for the abrogation of national rules and working conditions. In a decision rendered April 14, 1921, the Labor Board directed the officers and employees on each road to negotiate local agreements in accordance with the terms of the Transportation Act. The power of the Railway Employees Department of the American Federation of Labor, acquired during Federal control, was great enough, however, to prevent local modifications of the rules and in the absence of local or regional boards of adjustment the whole controversy was forced back before the Labor Board for final settlement. Obviously, any settlement other than on a national basis would have been extremely difficult if not impossible from a national body acting on evidence presented by the railroads as a whole. The perpetuation of national rules may therefore be attributed largely to the loss of morale and antagonism created between the men and railroad officers during the war. Had a reasonable degree of co-operation been possible, unhindered by outside influences, satisfactory local agreements might have been negotiated.

There are undoubtedly many features of the rules that are still unnecessarily restrictive. It is highly encouraging, however, to find a large measure of consideration for the practical necessities of railroad operation in the revised rules, which carries with it the inference at least that the purposes of railway officers in the discharge of their responsibility may not be entirely of evil origin. The fact that where the new rules are similar to those in the so-called national agreement they do not carry with them the interpretations of the United States Railroad Administration or its adjustment boards is further justification for a feeling of hope, since the general trend of the new rules suggests that a spirit of helpfulness may prevail in the establishment of future interpretations.

It is also worthy of note that where local agreements have been established, they are not disturbed by the new national rules. This fact, together with the provision of a new rule to protect unorganized or minority employees in representation of their own choosing in the handling of grievances, suggests that the whole course of future negotiations between the railroads and their shop employees depends largely on the nature of the relations that local officers are able to establish between themselves and their employees. A foundation has been laid on which it may be possible to rebuild a structure of mutual respect and co-operation, which in the long run will do more to restore efficient and economical maintenance of equipment than the complete elimination of all rules and working conditions, accomplished at the price of increased dissatisfaction and suspicion on the part of the shop employees.

Selecting Machine Tools

DURING the past year, the *Railway Mechanical Engineer* has given considerable space to the problem of properly selecting machine tools for railroad shops. Doubtless the greatest present difficulty is in getting necessary appropriations to pay for new machinery, but the problem of second importance is to know what machines should be purchased in order that appropriations already secured may be spent to the best advantage. It is felt, therefore, that in view of the great importance of the subject, another article on the "Selection of Railroad Shop Machine Tools," written by an expert on the subject and published elsewhere in this issue, will be read with interest.

The article is quite general in character and discusses the uses and advantages of different types of machines, but places particular emphasis upon production machine operations as performed on modern milling and grinding machines. It is pointed out that the plain and vertical knee-type milling machines have outgrown their toolroom days and reached a size and power warranting use for more general machine operations in railroad shops. There are many parts, such as pedestal shoes and wedges, rod keys and brasses, valve motion rods and many others too numerous to mention, for the machining of which knee-type millers are most effective tools. High production can be secured when using coarse tooth, high-speed steel cutters, adaptable to heavy feeds and speeds. In the case of the vertical spindle machine, both cutting feeds and speeds can be increased wherever the nature of the work permits steadying the lower end of the cutter by a supporting bracket bolted to the column of the machine.

Holding fixtures are extremely important and often limit the output, so neither time nor expense should be spared in providing a sufficient number of these capacity-increasing devices. It is pointed out, and truly, that many machine manufacturers maintain engineering service departments composed of experts whose duty it is to assist purchasers in getting the best results from modern machines. The railroads should benefit from the knowledge and experience of these men and consult them in designing special holding fixtures and determining the most effective methods of setting up work. The advantages of slab and heavy vertical millers for rod work are more generally understood by railroad men and receive only passing comment in the article.

In discussing the importance of grinding the statement is made that "In the railway shop of the future every smooth bearing surface that can be reached by a grinding wheel will be finished by grinding." This is a venturesome prophecy which may, and we hope will, be fulfilled in the near future, but the length of time needed to bring about the fulfillment can be greatly reduced by a more open-minded, receptive attitude on the part of many railroad shop men. Grinding

machines deserve a fair trial, which they have seldom had in railroad shops. It is not the purpose of this editorial to discuss the advantages of grinding at any great length, but as a machine operation it has proved invaluable in the automotive and other industries. Is there any essential reason why similar economies could not be effected by its use in railroad shops? Some railroad shop men are now awake to the value of grinding machines, but it is to be feared that many others do not realize the full possibilities. Doubters can be convinced by the simple expedient of visiting manufacturing plants and a few railroad shops now profiting by advanced grinding practice and seeing with their own eyes what is actually being accomplished.

Modern grinding machines are adapted to finishing certain machine parts from the rough, but probably their most effective use is in the rapid, smooth and accurate finishing of parts already roughed out on some other type of production machine. In addition to piston and valve rods, the plain cylindrical grinder is recommended for grinding both locomotive and car axles and the hope is expressed that manufacturers will some day develop a machine for grinding locomotive driving journals with the wheels mounted. For the heavy surface grinder, especially when equipped with a magnetic chuck, there are uses without number.

Another point strongly emphasized in the article is that the introduction of almost any modern machine will be followed by the development of unexpected uses. For example, a planetary, internal grinder was installed at a certain shop with more or less misgivings on the part of the management for fear there would not be enough internal grinding on valve motion levers, rod bushing and knuckle pin fits, etc., to keep the machine busy and pay interest on the investment. What was the result? It developed that triple valves could be reclaimed on this machine by grinding the worn cylinders and soon triple valves from all over the system were being sent in for repairs; the machine was overcrowded with work and it was found necessary to install a second one.

There is food for thought in the author's concluding statement: "If the manufacturers who are in the business to make money find grinding a paying proposition, the process must possess merits that railroad men cannot afford to ignore."

NEW BOOKS

Material Handling Cyclopedia. Edited by Roy V. Wright and John G. Little. Bound in cloth and leather; 850 pages, 1,500 illustrations. 11½-in. by 8½-in. Published by the Simmons-Boardman Publishing Company, Woolworth Building, New York City. Price, cloth $10.00, leather, $15.00.

This is the latest addition to the library of transportation literature published by the Simmons-Boardman Publishing Company. The volume is a companion book of the Car Builders' Dictionary and Cyclopedia, the Locomotive Dictionary and Cyclopedia, the Shipbuilding Cyclopedia and the Maintenance of Way Cyclopedia.

The purpose of this cyclopedia has been to bring together in a single volume complete, practical working information about the many types of material handling devices used in industry. It has been the aim to make the contents of interest and value alike to the executive interested in reducing handling costs and to the operating man who is seeking information as to the types of material handling machines best suited for his needs, how they operate and where they may be obtained.

The Definition Section in addition to its purpose as a dictionary of material handling items, methods and devices, serves as an index to other sections of the book. Following the definition of each device receiving further treatment in the book is a reference to the page in the Text Section or Catalog Section on which the additional information appears. Thus, from the definition the reader is referred not only to the detail description, method of operation, and illustration of the device given in the Text Section, but as well to the page in the Catalog Section where the device which he has selected as best suited for his needs is described authoritatively by the manufacturers.

The Illustrated Text Section, which directly follows the Definition Section, has been sub-divided into divisions corresponding to the general classification of machines. Thus the text contains separate sections devoted to Hoisting Machinery; Conveyors; Elevators; Industrial and Motor Trucks, Tractors and Trailers; Industrial Rail Transportation Track, Cars and Locomotives, and Handling Systems. Each section is fully illustrated, the illustrations showing typical applications of the various machines as well as their general characteristics and appearances.

A Catalog Section of 150 pages supplements the information shown elsewhere in the book. In it the manufacturers of machines present detail descriptions and illustrations of particular devices referred to in the other sections of the book.

A General Subject Index covering the entire contents of the book is an additional help in making the information readily available.

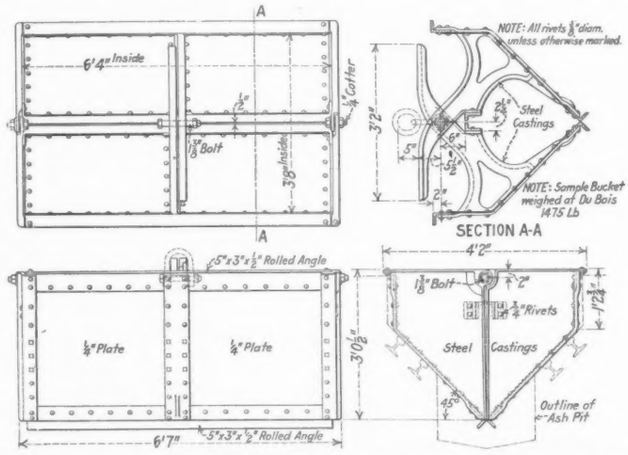
COMMUNICATIONS

A Substantial Cinder Pit Bucket

DU BOIS, PA.

TO THE EDITOR:

On page 707 of the November *Railway Mechanical Engineer* there is an article entitled "Construction and Maintenance of Cinder Pits," describing and illustrating forms of



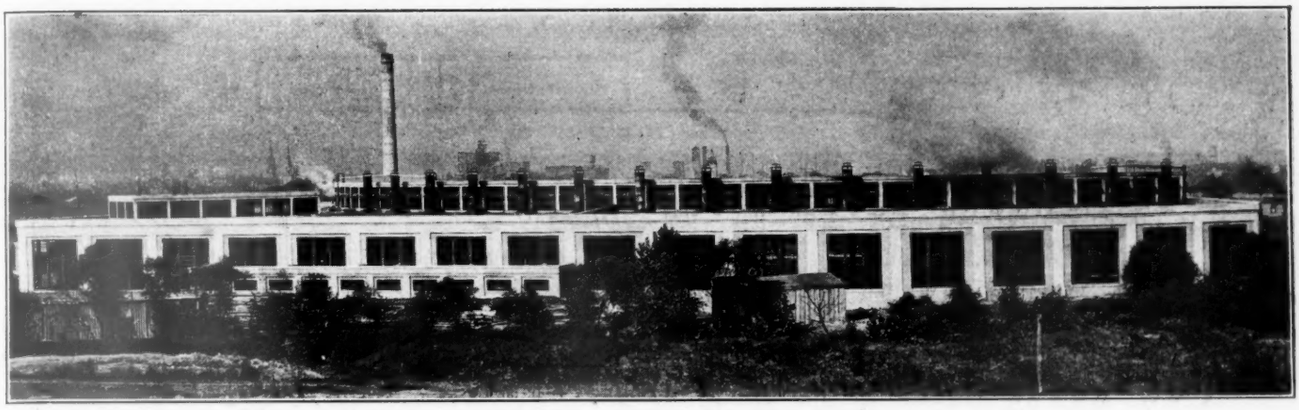
Cinder Grab Bucket Made with Cast Steel Ends, Tie Members and Scissor Arms

pits and apparatus for handling cinders, as employed by a number of railroads.

Fig. 4, page 708, describes a type of pit employed by the Buffalo, Rochester & Pittsburgh. When first put in service the buckets used with this arrangement were constructed of rolled shapes, plates and forgings, and the rapidity with which they were destroyed on account of the hot ashes and the resultant warping and corrosion was rather alarming.

With a view to prolonging the life of the buckets, a design was prepared and buckets built having cast steel ends, cast steel tie members and cast steel scissor arms. The accompanying drawing illustrates the buckets now used from which long service is obtained at a small cost for upkeep.

WILLIAM J. KNOX,
Mechanical Engineer, B. R. & P.



The Simplicity and Harmony of the Design Is Admirably Shown Here

New Roundhouse and Shops for Central of Georgia

Columbus, Ga., Locomotive Terminal a Compact, Well Equipped, United Plant, Designed for Economical Operation

By W. H. Fetner
Superintendent of Motive Power, Central of Georgia

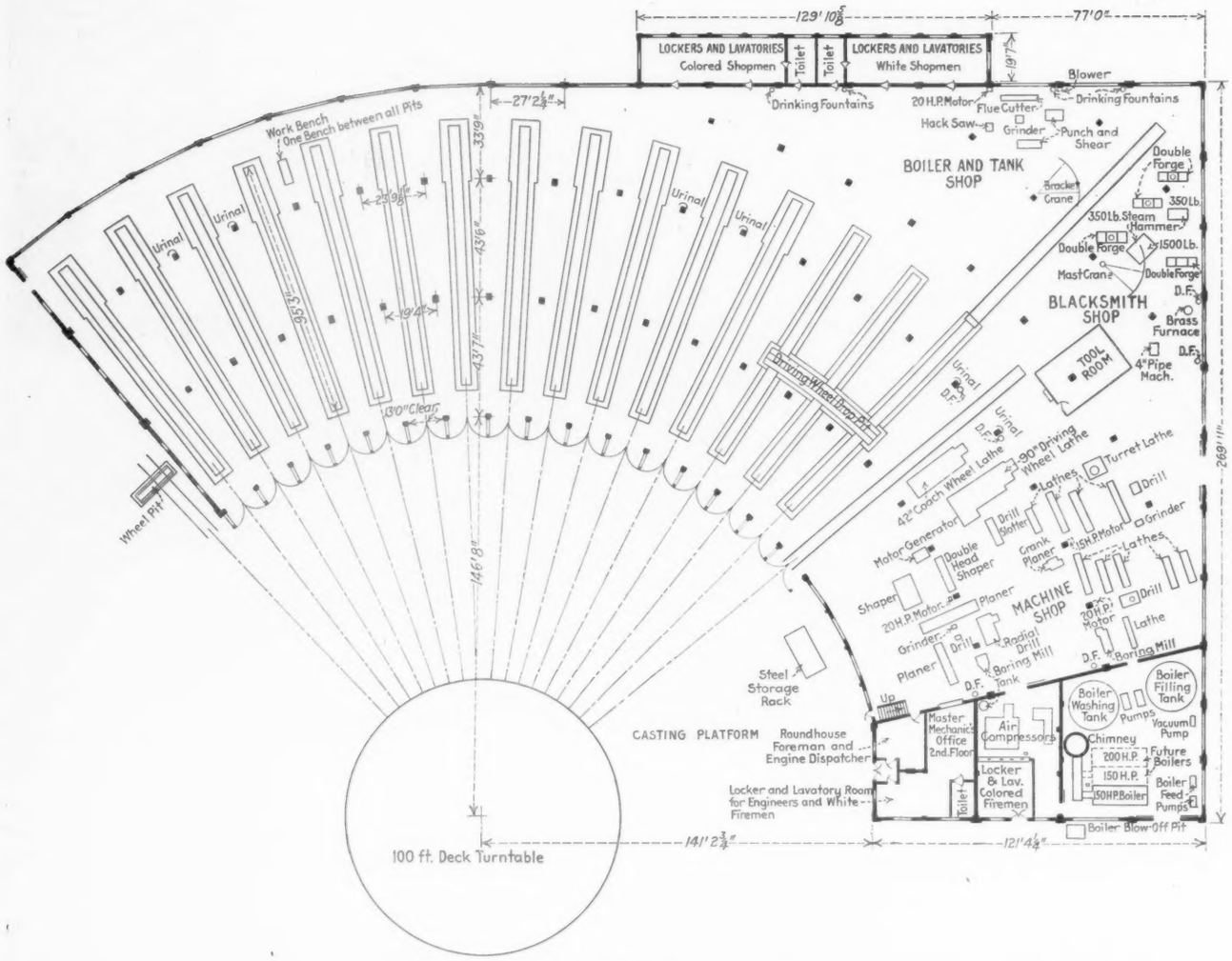
THE Columbus division of the Central of Georgia, between Birmingham, Ala., and Columbus, Ga., carries a heavy traffic from the Birmingham coal and iron fields. For handling this business locomotives of the 2-6-6-2 Mallet type are used. The Eastern terminus of this division is at Columbus which is 100 miles from Macon, Ga., where the principal shops of the road are located. In order to take care of this power properly, the Central of Georgia has replaced the terminal facilities at this point, which were formerly inadequate, with a new terminal which is equipped with all the facilities needed for making running or heavy repairs to the Mallet engines. The new terminal is really a combined shop and roundhouse, as the one building has 15 radial tracks served by a traveling crane, and a machine, boiler and blacksmith shop all under one roof. This arrangement was chosen because experience with a combined roundhouse and shop on another division had proved economical in operation, especially as regards supervision.

The shape of the building was largely determined by the site on which it is located. The stalls are laid out in the usual manner around a 100-ft. turntable. Fifteen stalls have now been built, but the plan provides for nine more stalls whenever the space is needed. The shop is located in an extension of the roundhouse. The outer walls of the building follow the pits for the first seven stalls, and then extend out in a straight line, forming one wall of the shop section. The other wall of the shop extends at right angles, making the outline of the house partly circular and partly rectangular and giving a triangular space for the shop between the walls and the outer ends of the pits, in addition to that formed by extending the circle beyond the stalls.

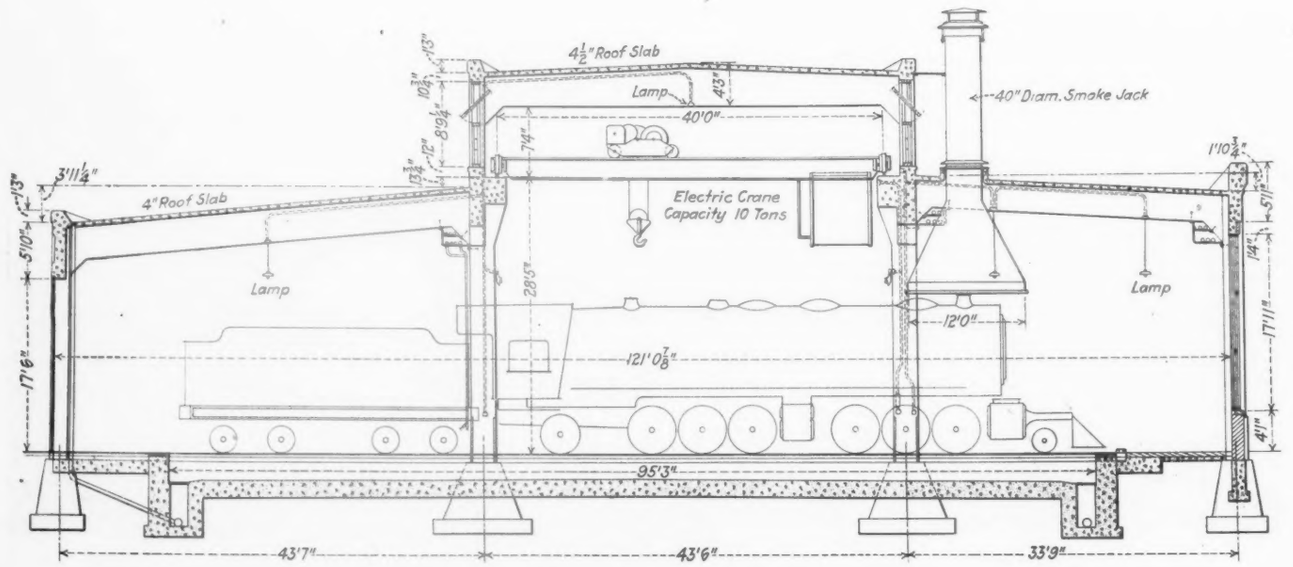
The roundhouse is of reinforced concrete construction throughout with wood block floors. The stalls are 120 ft. long divided into three sections, the center section forming a monitor and being equipped with a 10-ton electric overhead crane which serves the 15 pits and the machine shop as well. The long spans in the roundhouse increase the cost of the building somewhat, but the unobstructed working space between the pits is a decided advantage. The distance from the center of the turntable to the inner wall of the roundhouse has been made great enough to give a 13 ft. clear door opening without having the tracks cross before reaching the turntable, thus avoiding frogs which are expensive to maintain. The 100-ft. turntable is operated by a 30 h.p. motor.

A continuation of the roundhouse, equivalent to four stalls, is now used in conjunction with the triangular portion of

The Effectiveness of the Lighting and Ventilation Produces a Clear Interior



General Floor Plan of Roundhouse and Shops



Section Through Typical Roundhouse Stall

the building for machine tools. The three stalls adjacent to the machine shop are fitted up with drop pits to take care of all driving wheel repairs. All three pits are connected and equipped with an air jack and truck. A tender wheel drop pit with an air jack is provided outside of the building.

Two cinder pits are located in the yard, the ashes being handled by two double bucket conveyors.

The equipment of shop tools is adequate for taking care of the heaviest class of repair work. The layout has been carefully planned to give the most convenient arrangement. The two heaviest tools, a heavy duty 90-in. driving wheel lathe and a 42-in. wheel lathe, both with individual motor drive, have been located close to the drop pits and wheel tracks and under the traveling crane. In addition, the following tools are also served by the crane:

One 100-ton hydraulic press.
One 6-ft. radial drill—motor-driven.
One 18-in. rapid production slotter—motor-driven.
One 25-in. heavy duty lathe—motor-driven.
One 24-in. crank planer—motor-driven.

The remaining machine tools are arranged in three groups, each group being motor driven and consisting of the following:

GROUP NO. 1

One 26-in. double-head shaper.
One 20-in. single-head shaper.
Two 36-in. planers.
One twist drill grinder.
One 20-in. emery grinder.
One 51-in. boring mill.
One 16-in. shaper.
One 20-in. double head grinder.

GROUP NO. 2

One 27-in. lathe.
One 24-in. lathe.
Two 18-in. lathes.
One 4-ft. drill.
One 2-in. double head bolt cutter.
One 36-in. vertical turret.

GROUP NO. 3

One 36-in. lathe.
One 24-in. lathe.
One 14-in. lathe.
One 18-in. turret lathe.
One 3-in. turret lathe.
One 4-ft. radial drill.
One 12-in. brass lathe.
One 3-in. by 36-in. turret lathe.
One sensitive drill.
One horizontal boring mill.

A 10-ton capacity overhead traveling electric crane operates the entire length of the center bay, passing over the 15 engine pits in the roundhouse, the drop pits and the machine shop.

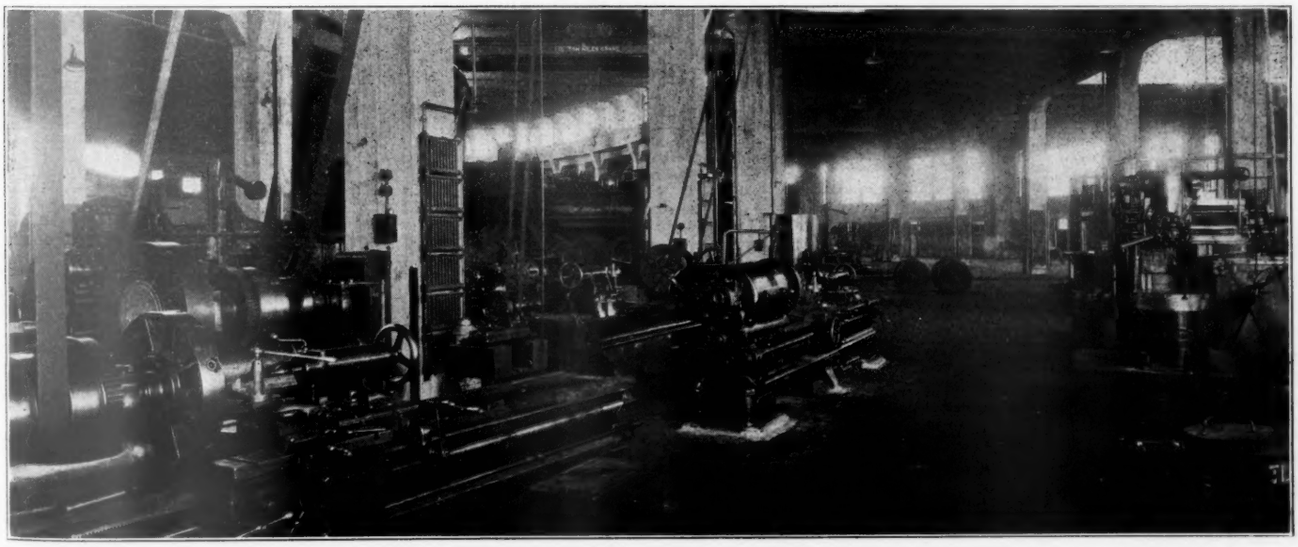
The Beginning of the Radial Section—A Business-Like Round House

Jib and bracket cranes are provided in the machine and blacksmith shops.

The pipe shop is equipped with a 4-in. motor-driven pipe machine. A tilting brass furnace using crude oil as fuel, two coke metal fires and a portable fuel oil burner are used for heating and metaling crosshead shoes, etc.

A tool room 20 ft. by 20 ft. is located in a position convenient for the machine shop and roundhouse forces and is well equipped with shelving and racks for holding the equipment.

The blacksmith shop is equipped with two double forges with space for doubling this capacity in the future. There is also one open or heavy fire served by a two-ton mast crane which also serves the 1,500-lb. steam hammer. A 350-lb. steam hammer takes care of the small work. Other tools



An Interior View Showing the Crane Bay

and facilities have been installed in quantity and character necessary to round out the facilities in making economical repairs. A No. 7 blower supplies the blast for the forges and fires in the blacksmith shop and also takes care of the flange fire in the boiler shop.

The boiler shop is provided with two punching and shearing machines, a double head grinder, a hack saw and a flue cutter. The flange fire is served by a two-ton bracket crane. The boiler and power house contains one water-tube boiler of 150 hp. capacity. Foundations have been provided for the future installation of additional boilers. The chimney of reinforced concrete, 110 ft. high, is located in the boiler room and is designed to care for 500 boiler hp. A creosoted timber trestle is located outside of the boiler room and provides for the delivery of coal by gravity to the boiler room door.

The air compressor room contains two compressors of the two-stage type, one of 1,000 cu. ft. capacity and one of 320 cu. ft. capacity, both motor driven. The whole plant is liberally supplied with air pipe lines and drops.

A strictly modern boiler washing plant is located in the boiler room. This consists of pumps, tanks, etc., with a pipe line and drop running to each engine stall. The boiler feedwater is taken from these tanks by a duplex plunger pump and delivered to the boiler at 160 deg. F. This arrangement supplies the boiler with clean, hot water and a feedwater heater is not required.

No provision was made for generating electric current as the current for light and power is obtained from a local hydro-electric company at a reasonable rate. A fireproof brick and concrete transformer house, just south of the main building, receives current at 11,000 volts which is stepped down to 440 volts for use in the shops. A motor-generator set supplies the direct current required for the motor-driven wheel lathes and other machines where alternating current can not be used.

The buildings are unusually well provided with windows for natural light and, in addition, a very effective lighting system has been worked out. The absence of shadows is particularly noticeable.

Shops, locker rooms and offices are heated by a direct radiation vacuum-return, low-pressure steam system. Cast-iron wall radiators are located in the columns and on the brick walls beneath the windows. Radiation in the engine pits is not necessary in this climate.

Ample provision has been made for locker room and toilet facilities, separate accommodations being provided for white and colored employees. Individual wash basins are used and shower baths with hot and cold water are supplied as well as sanitary water closets and steel lockers. Similar conveniences and accommodations have been provided for the engineers and firemen. Sanitary drinking fountains and urinals are conveniently located in the roundhouse and shops.

Additional terminal developments in Columbus which will be made at some future time include a modern coaling station and inspection pit and a rearrangement of the freight yard.

Excellent Facilities Are Provided in the Machine Shop

New Freight Locomotives for Russia

The first of an order of 1,000 locomotives of the 0-10-0 type for the Russian government has recently been delivered by the Nydquist and Holm Aktiebolag of Trollhattan, Sweden. The company's contract calls for the delivery of 50 locomotives this year, 200 next year, and 250 in each of the three subsequent years.

Many of the principal dimensions of these locomotives correspond closely with the Russian 2-10-0 type built by American and Canadian companies during the war, some of which are now in service in this country. The locomotives built in Sweden, however, have slab frames and Belpaire fireboxes. The tabulation shows a comparison of the principal dimensions of the Swedish built 0-10-0 and the American built 2-10-0 types.

	0-10-0	2-10-0
Type	0-10-0	2-10-0
Gage	5 ft.	5 ft.
Cylinders, diameter	25.59 in.	25 in.
Cylinders, stroke	27.56 in.	28 in.
Driving wheels, diameter	51.97 in.	52 in.
Boiler heating surface	2,229.2 sq. ft.	2,610 sq. ft.
Superheater surface	548.2 sq. ft.	579 sq. ft.
Working pressure	170.6 lb. per sq. in.	180 lb. per sq. in.
Grate area	48 sq. ft.	64.6 sq ft.
Tractive effort	38,500 lb.	51,506 lb.
Weight in working order	178,000 lb.	201,000 lb.
Maximum height above rail	17 ft. 1 in.	16 ft. 11 in.

On account of the extreme height of these engines and the broad gage, it was necessary to dismantle them and ship them on trucks, or special wheels by rail through Sweden and Finland.

New Rules for Shop Crafts Issued by Labor Board

Provisions Made More Elastic; Rights of Minorities Recognized—Many Old Rules Retained

AN important decision announcing new rules governing the working conditions for the 400,000 employees in the mechanical departments of the railroads, was handed down by the Labor Board on December 1, becoming effective the same date. The board estimated that the rules might save the roads as much as $50,000,000 a year. In general, the new rules are similar to the National Agreement, but include revisions which eliminate some of the provisions which proved serious handicaps to the economical operation of shops and roundhouses. The most important changes are those relating to overtime and piecework which were announced earlier in Decision 222, issued by the Labor Board in August, and addendum No. 3 to Decision 222, issued in October.

In the announcement of the decision, the Labor Board stated that the rules had been made more elastic to secure greater efficiency. Many criticisms of the National Agreement have been met, but older rules sanctioned by experience are retained. The principle of collective bargaining and union recognition embodied in the Transportation Act is retained in the new rules while representation of minorities in grievance cases is provided for, thus doing away with that part of the National Agreement criticized as forcing the closed shop on the railroads.

The National Agreement contained 186 rules and of these 99 are to be continued. Of the remainder, 14 have been eliminated and minor changes have been made in the others. All of the rules outlining qualifications for the various classes of shopmen have been retained with the exception of a slight change in the case of electrical workers. The rules relating to the classification and services of apprentices, the eligibility of helpers for promotion to helper apprentices, and the differential rules for autogenous welders have been perpetuated. Of the rules eliminated, the most important is Rule 24 relating to court duties of employees.

Several changes have been made which undoubtedly will give railroad officers better control of shop conditions. Rule 27 has been changed so that shop hours may be reduced to 40 hours per week before reductions in the force are made. Another important change is included in Rule 40 which creates three classes of apprentices: regular, helper and special. Provisions are made for three-year special apprenticeships for young men with technical school training.

Rules 32 and 33 have been changed so that men at outlying points may be permitted to perform repair work other than that listed for their crafts instead of necessitating temporary transfers of employees at heavy expense. The rigid limitations on the work performed by each craft have been modified by changes in the rules which permit a machinist to do any connecting or disconnecting of wires, couplings or pipe connections, necessary to complete his work.

In general, the changes in the rules are such as to promote more economical and efficient operation, especially when compared with conditions during Federal control. It is significant that the decision closes with a statement that those rules which are identical with rules of the National Agreement are not to be understood as carrying with them the interpretations placed upon them by the Railroad Administration, or by the Adjustment Boards, or by other agencies acting under the administration.

The complete text of the new rules, including the special rules for each craft, is given herewith:

General Rules

NOTE—For the purpose of ready reference, the rules previously adopted and promulgated by the Labor Board are hereby reproduced and are indicated as follows: A single asterisk is used to designate the rules, effective August 16, 1921, which were approved by the Labor Board and promulgated in Decision No. 222. A double asterisk is used to designate the rules effective October 16, 1921, which were approved by the Labor Board and promulgated in Addendum No. 3 to Decision No. 222.

Hours of Service

**Rule 1—Eight hours shall constitute a day's work. All employees coming under the provisions of this agreement, except as otherwise provided in this schedule of rules, or as may hereafter be legally established between the carrier and the employees, shall be paid on the hourly basis.

This rule is intended to remove the inhibition against piece work contained in rule 1 of the shop crafts' national agreement and to permit the question to be taken up for negotiation on any individual railroad in the manner prescribed by the Transportation Act.

**Rule 2—There may be one, two or three shifts employed. The starting time of any shift shall be arranged by mutual understanding between the local officers and the employees' committee based on actual service requirements.

The time and length of the lunch period shall be subject to mutual agreement.

**Rule 3, Rule 4, Rule 5—Provided for in Rule 2.

Overtime—Emergency Service—Road Work

Rule 6—All overtime continuous with regular bulletined hours will be paid for at the rate of time and one-half until relieved, except as may be provided in rules hereinafter set out.

Work performed on Sundays and the following legal holidays—namely, New Year's Day, Washington's Birthday, Decoration Day, Fourth of July, Labor Day, Thanksgiving Day and Christmas (provided when any of the above holidays fall on Sunday, the day observed by the State, Nation or proclamation shall be considered the holiday), shall be paid for at the rate of time and one-half, except that the employees necessary to the operation of power houses, millwright gangs, heat-treating plants, train yards, running-repair and inspection forces, who are regularly assigned by bulletin to work on Sundays and holidays, will be compensated on the same basis as on week days. Sunday and holiday work will be required only when absolutely essential to the continuous operation of the railroad.

*Rule 7—For continuous service after regular working hours, employees will be paid time and one-half on the actual minute basis with a minimum of one hour for any such service performed.

Employees shall not be required to work more than two hours without being permitted to go to meals. Time taken for meals will not determine the continuous service period and will be paid for up to 30 minutes.

Employees called or required to report for work and reporting but not used will be paid a minimum of four hours at straight-time rates.

Employees called or required to report for work and reporting will be allowed a minimum of four hours for two hours and 40 minutes or less, and will be required to do only such work as called for or other emergency work which may have developed after they were called and cannot be performed by the regular force in time to avoid delays to train movement.

Employees will be allowed time and one-half on minute basis for services performed continuously in advance of the regular working period with a minimum of one hour—the advance period to be not more than one hour.

Except as otherwise provided for in this rule, all overtime beyond 16 hours' service in any 24-hour period, computed from starting time of employees' regular shift, shall be paid for at rate of double time.

**Rule 8—Employees regularly assigned to work on Sundays or holidays, or those called to take the place of such employees, will be allowed to complete the balance of the day unless released at their own request. Those who are called will be advised as soon as possible after vacancies become known.

*Rule 9—Employees required to work during, or any part of, the lunch period, shall receive pay for the length of the lunch period regularly taken at point employed at straight time and will be allowed necessary time to procure lunch (not to exceed thirty minutes) without loss of time.

This does not apply where employees are allowed the 20 minutes for lunch without deduction therefor.

*Rule 10—An employee regularly assigned to work at a shop, engine house, repair track, or inspection point, when called for emergency road work away from such shop, engine house, repair track, or inspection point, will be paid from the time ordered to leave home station until his return for all time worked in accordance with the practice at home station and straight-time rate for all time waiting or traveling.

If during the time on the road a man is relieved from duty and permitted to go to bed for five or more hours, such relief time will not be paid for, provided that in no case shall he be paid for a total of less than eight hours each calendar day, when such irregular service prevents the employee from making his regular daily hours at home station. Where meals and lodging are not provided by railroad, actual necessary expenses will be allowed.

Employees will be called as nearly as possible one hour before leaving time, and on their return will deliver tools at point designated.

If required to leave home station during overtime hours, they will be allowed one hour preparatory time at straight-time rate.

Wrecking-service employees will be paid under this rule, except that all time working, waiting or traveling on Sundays and holidays will be paid for at rate of time and one-half, and all time working, waiting or traveling on week days after the recognized straight-time hours at home station will also be paid for at rate of time and one-half.

Distribution of Overtime

Rule 11—When it becomes necessary for employees to work overtime they shall not be laid off during regular working hours to equalize the time.

At points where sufficient number of employees are employed, employees shall not (except as provided in rule 6 of Decision 222) work two consecutive Sundays (holidays to be considered as Sundays).

Record will be kept of overtime worked and men called with the purpose in view of distributing the overtime equally.

Temporary Vacancies

*Rule 12—Employees sent out to temporarily fill vacancies at an outlying point or shop, or sent out on a temporary transfer to an outlying point or shop, will be paid continuous time from time ordered to leave home point to time of reporting at point to which sent, straight-time rates to be paid for straight-time hours at home station and for all other time, whether waiting or traveling. If on arrival at the outlying point there is an opportunity to go to bed for five hours or more before starting work, time will not be allowed for such hours.

While at such outside point they will be paid straight time and overtime in accordance with the bulletin hours at that point, and will be guaranteed not less than eight hours for each day.

Where meals and lodgings are not provided by the company, actual necessary expenses will be allowed.

On the return trip to the home point, straight time for waiting or traveling will be allowed up to the time of arrival at the home point.

Overtime Changing Shifts

Rule 13—Employees changed from one shift to another will be paid overtime rates for the first shift of each change. Employees working two shifts or more on a new shift shall be considered transferred. This will not apply when shifts are exchanged at the request of the employees involved.

Overtime Regular Assigned Road Work

*Rule 14—Employees regularly assigned to road work whose tour of duty is regular and who leave and return to home station daily (a boarding car to be considered a home station), shall be paid continuous time from the time of leaving the home station to the time they return whether working, waiting or traveling, exclusive of the meal period, as follows:

Straight time for all hours traveling and waiting, straight time for work performed during regular hours, and overtime rates for work performed during overtime hours. If relieved from duty and permitted to go to bed for five hours or more, they will not be allowed pay for such hours. Where meals and lodging are not provided by the company when away from home station, actual expenses will be allowed.

The starting time to be not earlier than 6 a. m. nor later than 8 a. m.

Where two or more shifts are worked, the starting time will be regulated accordingly.

Where employees are required to use boarding cars, the railroad will furnish sanitary cars and equip them for cooking, heating and lodging; the present practice of furnishing cooks and equipment, and maintaining and operating the cars, shall be continued.

Exception. In case where the schedule of trains interferes with the starting time an agreement may be entered into by the superintendent of the department affected and the general chairman of the craft affected.

*Rule 15—Employees regularly assigned to perform road work and paid on a monthly basis shall be paid not less than the minimum hourly rate established for the corresponding class of employees coming under the provisions of this schedule on the basis of 365 eight-hour days per calendar year. The monthly salary is arrived at by dividing the total earnings of 2,920 hours by 12; no overtime is allowed for time worked in excess of eight hours per day; on the other hand, no time is to be deducted unless the employee lays off of his own accord.

The regularly assigned road men under the provisions of this rule may be used, when at home point, to perform shop work in connection with the work of their regular assignments.

Where meals and lodging are not furnished by the railroad, or when the service requirements make the purchase of meals and lodging necessary while away from home point, employees will be paid necessary expenses.

If it is found that this rule does not produce adequate compensation for certain of these positions by reason of the occupants thereof being required to work excessive hours, the salary for these positions may be taken up for adjustment.

Filling Vacancies

Rule 16—When an employee is required to fill the place of another employee receiving a higher rate of pay, he shall receive the higher rate; but if required to fill temporarily the place of another employee receiving a lower rate, his rate will not be changed.

Rule 17—Employees serving on night shifts desiring day work shall have preference when vacancies occur, according to their seniority.

**Rule 18—When new jobs are created or vacancies occur in the respective crafts, the oldest employees in point of service shall, if sufficient ability is shown by trial, be given preference in filling such new jobs or any vacancies that may be desirable to them. All vacancies or new jobs created will be bulletined.

Bulletins must be posted five days before vacancies are filled permanently. Employees desiring to avail themselves of this rule will make application to the official in charge and a copy of the application will be given to the local chairman.

An employee exercising his seniority rights under this rule will do so without expense to the carrier; he will lose his right to the job he left; and if after a fair trial he fails to qualify for the new position, he will have to take whatever position may be open in his craft.

Rule 19—Mechanics in service will be considered for promotion to positions of foremen. When vacancies occur in position of gang foremen, men from the respective crafts will have preference in promotion.

Rule 20—Employees transferred from one point to another, with a view to accepting a permanent transfer, will, after 30 days, lose their seniority at the point they left, and their seniority at the point to which transferred will begin on date of transfer, seniority to govern. Employees will not be compelled to accept a permanent transfer to another point.

Rule 21—When the requirements of the service will permit, employees, on request, will be granted leave of absence for a limited time with privilege of renewal. An employee absent on leave who engages in other employment will lose his seniority, unless special provisions shall have been made therefor by the proper official and committee representing his craft.

The arbitrary refusal of a reasonable amount of leave to employees when they can be spared, or failure to handle promptly cases involving sickness or business matters of serious importance to the employee, is an improper practice and may be handled as unjust treatment under this agreement.

Rule 22—In case an employee is unavoidably kept from work he will not be discriminated against. An employee detained from work on account of sickness or for any other good cause shall notify his foreman as early as possible.

Faithful Service

Rule 23—Employees who have given long and faithful service in the employ of the company and who have become unable to handle heavy work to advantage, will be given preference of such light work in their line as they are able to handle.

Paying Off

Rule 25—Employees will be paid off during their regular working hours, semi-monthly, except where existing State laws provide a more desirable paying-off condition.

Should the regular pay day fall on a holiday or days when the shops are closed down, men will be paid on the preceding day.

Where there is a shortage equal to one day's pay or more in the pay of an employee, a voucher will be issued to cover the shortage.

Employees leaving the service of the company will be furnished with a time voucher covering all time due within 24 hours where time vouchers are issued and within 60 hours at other points, or earlier when possible (Sundays and holidays excepted).

Rule 26—During inclement weather provision will be made where buildings are available to pay employees under shelter.

Reduction of Forces

Rule 27—When it becomes necessary to reduce expenses, the hours may be reduced to 40 per week before reducing the force. When the force is reduced, seniority as per rule 31 will govern, the men affected to take the rate of the job to which they are assigned.

Forty-eight hours' notice will be given before hours are reduced. If the force is to be reduced, four days' notice will be given the men affected before reduction is made, and lists will be furnished the local committee.

In the restoration of forces, senior lay-off men will be given preference in returning to service, if available within a reasonable time, and shall be returned to their former positions if possible, regular hours to be re-established prior to any additional increase in force.

The local committee will be furnished a list of men to be restored to service. In the reduction of the force the ratio of apprentices shall be maintained.

Rule 28—Employees laid off on account of reduction in force, who desire to seek employment elsewhere, will, upon application, be furnished with a pass to any point desired on the same railroad.

Rule 29—When reducing forces, if men are needed at any other point, they will be given preference to transfer to nearest point, with privilege of returning to home station when force is increased, such transfer to be made without expense to the company. Seniority to govern all cases.

Rule 30—Employees required to work when shops are closed down, due to breakdown in machinery, floods, fires, and the like, will receive straight time for regular hours, and overtime for overtime hours.

Seniority

**Rule 31—Seniority of employees in each craft covered by this agreement shall be confined to the point employed in each of the following departments, except as provided in special rules of each craft: Maintenance of way (bridge and building where separate from maintenance of way department). Maintenance of equipment. Maintenance of telegraph. Maintenance of signals. Four subdivisions of the carmen as follows: Pattern makers, upholsterers, painters, other carmen.

The seniority lists will be open to inspection and copy furnished the committee.

Assignment of Work

Rule 32—None but mechanics or apprentices regularly employed as such shall do mechanics' work as per special rules of each craft, except foremen at points where no mechanics are employed.

This rule does not prohibit foremen in the exercise of their duties to perform work.

At outlying points (to be mutually agreed upon) where there is not sufficient work to justify employing a mechanic of each craft, the mechanic or mechanics employed at such points will, so far as capable, perform the work of any craft that may be necessary.

Rule 33—In compliance with the special rules included in this agreement,

none but mechanics and their apprentices in their respective crafts shall operate oxyacetylene, thermit, or electric welders. Where oxyacetylene or other welding processes are used, each craft shall perform the work which was generally recognized as work belonging to that craft prior to the introduction of such processes, except the use of cutting torch when engaged in wrecking service or in cutting up scrap.

When performing the above work for four hours or less in any one day, employees will be paid the welders' rate of pay on the hourly basis with a minimum of one hour; for more than four hours in any one day, welders' rate of pay will apply for that day.

Foremanship, Filling Temporarily

Rule 34—Should an employee be assigned temporarily to fill the place of a foreman, he will be paid his own rate—straight time for straight-time hours and overtime rate for overtime hours—if greater than the foreman's rate; if it is not, he will get the foreman's rate. Said positions shall be filled only by mechanics of the respective craft in their departments.

Grievances

Rule 35—Should any employee subject to this agreement believe he has been unjustly dealt with, the case shall be taken to the foreman, general foreman, master mechanic, or shop superintendent, each in their respective order, by the duly authorized local committee or their representative. Nothing herein contained shall infringe upon the right of employees not members of the organization representing the majority to present grievances in person or by representatives of their own choice.

If stenographic report of the investigation is taken, the aggrieved employee or his representatives shall be furnished a copy.

If the result still be unsatisfactory, the right of appeal shall be granted; the appeal to be made, preferably in writing, to the higher officials designated to handle such matters in their respective order and conferences will be granted within ten days of application.

All conferences between local officials and local committees to be held during regular working hours without loss of time to committeemen or other employee representation.

Rule 36—Should the highest designated railroad official, or his duly authorized representative, and the aggrieved employee, or his representative, as provided in first paragraph of rule 35, fail to agree, the case shall then be handled in accordance with the Transportation Act, 1920.

Prior to the assertion of grievances as herein provided, and while questions of grievances are pending, there will neither be a shutdown by the employer nor a suspension of work by the employees.

Rule 37—No employee shall be disciplined without a fair hearing by a designated officer of the carrier. Suspension in proper cases pending a hearing, which shall be prompt, shall not be deemed a violation of this rule. At a reasonable time prior to the hearing such employee will be apprized of the precise charge against him. The employee shall have reasonable opportunity to secure presence of necessary witnesses and shall have the right to be there represented by counsel of his choosing. If it is found that an employee has been unjustly suspended or dismissed from the service, such employee shall be reinstated with his seniority rights unimpaired, and compensated for the wage loss, if any, resulting from said suspension or dismissal.

Rule 38—Included in rule 37.

Committees

Rule 39—The company will not discriminate against any committeemen who, from time to time, represent other employees, and will grant them leave of absence and free transportation when delegated to represent other employees.

Apprentices

Rule 40—There will be three recognized classes of apprentices—namely, regular, helper, and special.

All apprentices must be able to speak, read and write the English language and understand at least the first four rules of arithmetic.

Applicants for regular apprenticeship shall be between 16 and 21 years of age, and, if accepted, shall serve four years of 290 days each calendar year. If retained in the service at the expiration of their apprenticeship, they shall be paid not less than the minimum rate established for journeymen mechanics of their respective crafts.

In selecting helper apprentices, ability and seniority will govern and all selections will be made in conjunction with the respective craft shop committees.

Note—See special rules of each craft for additional apprentice rules.

Rule 40½—Special apprentices shall be selected from young men between the ages of 18 and 26 years who have had a technical school education, and shall serve three years of 290 days each calendar year.

Special apprentices shall receive training in the various departments in the different classes of work of the different crafts in the maintenance of equipment departments, and may be moved from place to place or on any class of work at the discretion of the management.

In computing the ratio of apprentices to mechanics, special apprentices will be included, the number of same not to exceed 5 per cent of the total.

If retained in the service at the completion of the three-year course, the apprentice may choose the craft he desires employment in and shall receive a special rate for the period of one year, at the expiration of which time he shall be classified and receive the minimum rate of the craft employed in.

The rate of pay for special apprentices for the first three years shall be not less than that of helper apprentices.

Rule 41—All apprentices must be indentured and shall be furnished with a duplicate of indenture by the company, who will also furnish every opportunity possible for the apprentice to secure a complete knowledge of the trade.

No apprentice will be started at points where there are not adequate facilities for learning the trade.

Rule 40 shall govern in the employment of apprentices.

FORM OF INDENTURE

This will certify that.....was employed as.....apprentice by the..... railroad at.....on.....19.... to serve four years, a minimum of 290 days each.

.....
(Title of officer in charge.)

SERVICE PERFORMED DURING APPRENTICESHIP

.....
.....
.....

This will certify that on.....19.....
.....completed the course of apprenticeship specified above and is entitled, if employed by the..... railroad, to the rates of pay and conditions of service of.....

.....
(Title of officer in charge.)

Note—The above form is to be used both for regular and helper apprentices. (Helper apprentices to serve three years.)

Rule 42—The ratio of apprentices in their respective crafts shall not be more than one to every five mechanics.

Two apprentices will not be worked together as partners.

The distribution of apprentices among shops where general repairs are made on the division shall be as nearly as possible in proportion to the mechanics in the respective trades employed therein.

In computing the number of apprentices that may be employed in a trade on a division, the total number of mechanics of that trade employed on the division will be considered.

If within six months an apprentice shows no aptitude to learn the trade, he will not be retained as an apprentice.

An apprentice shall not be dismissed or leave the service of his own accord, except for just and sufficient cause, before completing his apprenticeship.

Apprentices shall not be assigned to work on night shifts. An apprentice shall not be allowed to work overtime during the first three years of his apprenticeship.

If an apprentice is retained in the service upon completing the apprenticeship, his seniority rights as a mechanic will date from the time of completion of apprenticeship.

Preference will be given to sons of employees in the selection of apprentices to the extent of at least 80 per cent of the number employed.

Rates of Pay

Rule 43—The minimum rates of pay are the rates established by the Labor Board's Decision No. 147 and Addenda thereto and therefore do not apply to the carrier named in Decision No. 290 or any other carrier where wage adjustments have been made in accordance with the provisions of the Transportation Act, 1920, and the decisions of the Labor Board; these rates shall be incorporated in and become a part of this agreement or schedule, and shall remain in effect until or unless changed in the manner provided by the Transportation Act, 1920.

Rule 44, Rule 45—Included in rule 43.

Applicants for Employment

**Rule 46—Applicants for employment may be required to take physical examination at the expense of the carrier to determine the fitness of the applicant to reasonably perform the service required in his craft or class. They will also be required to make a statement showing addresses of relatives, necessary four years' experience, and name and local address of last employer.

Conditions of Shops

Rule 47—Good drinking water and ice will be furnished. Sanitary drinking fountains will be provided where necessary. Pits and floors, lockers, toilets, and wash rooms will be kept in good repair and in a clean, dry, and sanitary condition.

Shops, locker rooms, and wash rooms will be lighted and heated in the best manner possible consistent with the source of heat and light available at the point in question.

Personal Injuries

**Rule 48—Employees injured while at work will not be required to make accident reports before they are given medical attention, but will make them as soon as practicable thereafter. Proper medical attention will be given at the earliest possible moment and, when able, employees shall be permitted to return to work without signing a release pending final settlement of the case.

At the option of the injured party, personal injury settlements may be handled by the duly authorized representatives of the employee with the duly authorized representative of the carrier. Where death or permanent disability results from injury, the lawful heirs of the deceased may have the case handled as herein provided.

Notices

Rule 49—A place will be provided inside all shops and roundhouses where proper notices of interest to employees may be posted.

Shop Trains

**Rule 50—Existing conditions in regard to shop trains will be continued unless changed by mutual agreement, or unless, after disagreement between the carrier and employees, the dispute is properly brought before the Labor Board and the Board finds the continuance of existing conditions unjust and unreasonable, and orders same discontinued or modified.

The company will endeavor to keep shop trains on schedule time, properly heated and lighted, and in a safe, clean and sanitary condition. This not to apply to temporary service provided in case of emergency.

Free Transportation

Rule 51—Employees covered by this agreement and those dependent upon them for support will be given the same consideration in granting free transportation as is granted other employees in service.

General committees representing employees covered by this agreement to be granted the same consideration as is granted general committees representing employees in other branches of the service.

Protection of Employees

Rule 52—Employees will not be required to work on engines or cars outside of shops during inclement weather, if shop room and pits are available. This does not apply to work in engine cabs or emergency work on engines or cars set out for or attached to trains.

When it is necessary to make repairs to engines, boilers, tanks, and tank cars, such parts shall be cleaned before mechanics are required to work on same. This will also apply to cars undergoing general repairs.

Employees will not be assigned to jobs where they will be exposed to sand blast and paint blowers while in operation.

All acetylene or electric welding or cutting will be protected by a suitable screen when its use is required.

Emery Wheels and Grindstones

Rule 53—Emery wheels and grindstones will be installed at convenient places in the shop and will be kept true and in order.

Help to Be Furnished

Rule 54—When experienced helpers are available, they will be employed in preference to inexperienced men.

Laborers when used as helpers will be paid the helpers' rate.

Miscellaneous

**Rule 55—Work of scrapping engines, boilers, tanks, and cars or other machinery will be done by crews under the direction of a mechanic.

Rule 56—No employee will be required to work under a locomotive or car without being protected by proper signals. Where the nature of the work to be done requires it, locomotives or passenger cars will be placed over a pit, if available.

Rule 57—In shops and roundhouses not now equipped with connections for taking the steam from engines, arrangements will be made to equip them so that steam from locomotives will not be blown off inside the house.

Rule 58—All engines will be placed under smokejacks in roundhouses, where practicable, when being fired up.

Rule 59—At shops and roundhouses equipped with electricity, electric light globes and extensions will be kept in tool rooms available for use.

**Rule 60—At the close of each week one minute for each hour actually worked during the week will be allowed employees for checking in and out and making out service cards on their own time.

Machinists' Special Rules

Qualifications

**Rule 61—Any man who has served an apprenticeship or has had four years' experience at the machinists' trade and who, by his skill and experience, is qualified and capable of laying out and fitting together the metal parts of any machine or locomotive, with or without drawings, and competent to do either sizing, shaping, turning, boring, planing, grinding, finishing, or adjusting the metal parts of any machine or locomotive whatsoever shall constitute a machinist.

Classification of Work

Rule 62—Machinists' work shall consist of laying out, fitting, adjusting, shaping, boring, slotting, milling and grinding of metals used in building, assembling, maintaining, dismantling and installing locomotives and engines (operated by steam or other power), pumps, cranes, hoists, elevators, pneumatic and hydraulic tools and machinery, scale building, shafting and other shop machinery, ratchet and other skilled drilling and reaming; tool and die making, tool grinding and machine grinding, axle truing, axle, wheel and tire turning and boring; engine inspecting; air equipment, lubricator and injector work; removing, replacing, grinding, bolting, and breaking of all joints on superheaters; oxyacetylene, thermit and electric welding on work generally recognized as machinists' work; the operation of all machines used in such work, including drill presses and bolt threaders using a facing, boring or turning head or milling apparatus; and all other work generally recognized as machinists' work. On running repairs, machinists may connect or disconnect any wiring, coupling or pipe connections necessary to make or repair machinery or equipment.

This rule shall not be construed to prevent engineers, firemen and cranemen of steam shovels, ditchers, clam shells, wrecking outfits, pile drivers and other similar equipment requiring repairs on line of road from making any repairs to such equipment as they are qualified to perform.

Machinist Apprentices

Rule 63—Include regular and helper apprentices in connection with the work defined by rule 62.

Machinist Helpers

Rule 64—Helpers' work shall consist of helping machinists and apprentices, operating drill presses (plain drilling) and bolt threaders not using facing, boring or turning head or milling apparatus, wheel presses (on car, engine truck and tender truck wheels), nut tappers and faces, bolt pointing and centering machines, car brass boring machines, twist drill grinders; cranemen helpers on locomotive and car work; attending tool room, machinery oiling, locomotive oiling, box packing, applying and removing trailer and engine-truck brasses, assisting in dismantling locomotives and engines, applying all couplings between engine and tender; locomotive tender and draft-rigging work except when performed by carmen, and all other work generally recognized as helpers' work.

Assignment to Running Repairs

**Rule 65—Machinists assigned to running repairs shall not be required to work on dead work at points where dead-work forces are maintained except when there is not sufficient running repairs to keep them busy.

Dead Work

**Rule 66—Dead work means all work on an engine which cannot be handled within 24 hours by the regularly assigned running-repair forces maintained at point where the question arises.

Dead-Work and Running-Repair Forces

**Rule 67—Dead-work forces will not be assigned to perform running-repair work, except when the regularly assigned running-repair forces are unable to get engines out in time to prevent delay to train movement.

Work at Wrecks

**Rule 68—In case of wrecks where engines are disabled, machinist and helper, if necessary, shall accompany the wrecker. They will work under the direction of the wreck foreman.

Apprentices, Classification of Work

Rule 69—Apprentices shall be instructed in all branches of the machinists' trade. They will serve three years on machines and special jobs. Apprentices will not be required to work more than four months on any one machine or special job. During the last year of their apprenticeship they will work on the floor. Apprentices shall not work on oxyacetylene, thermit, electric, or other welding processes until they are in their last year.

Helper Apprentices

Rule 70—Helpers who have had not less than two consecutive years' experience as machinist helpers at the point where employed, at the time application for apprenticeship is made, may become helper apprentices. When assigned as helper apprentices they must not be over 25 years of age.

Rule 71—Helper apprentices shall serve three years, a minimum of 290 days each calendar year, and shall be governed by the same laws and rules as govern regular apprentices.

Rule 72—The number of helper apprentices must not at any time exceed 50 per cent of the combined number of regular and helper apprentices assigned.

Rule 73—Helper apprentices shall receive the minimum helper rate for the first six months, with an increase of two cents per hour for every six months thereafter until they have served three years.

Rule 74—Helpers, when used in any way in connection with machinists' work, shall in all cases work under the orders of the machinist, both under the direction of the foreman.

Rule 75—When vacancies occur under classification of machinist helper (temporarily or permanent), machinist helpers in the service will be given preference in promotion to position paying either same or higher rate at station employed, seniority to govern.

Rule 76—Eliminated.

Differentials for Machinists

**Rule 77—At points where there are ordinarily fifteen or more engines tested and inspected each month, and machinists are required to swear to Federal reports covering such inspection, a machinist will be assigned to handle this work in connection with other machinists' work and will be allowed five cents per hour above the machinists' minimum rate at the point employed.

At points or on shifts where no inspector is assigned and machinists are required to inspect engines and swear to Federal reports, they will be paid five cents per hour above the machinists' minimum rate at the point employed for the days on which such inspections are made.

Autogenous welders shall receive five cents per hour above the minimum rate paid mechanics at the point employed.

Boilermakers' Special Rules

Qualifications

**Rule 78—Any man who has served an apprenticeship, or has had four (4) years' experience at the trade, who can with the aid of tools, with or without drawings, and is competent to either lay out, build or repair boilers, tanks, and details thereof, and complete same in a mechanical manner, shall constitute a boilermaker.

Classification of Work

Rule 79—Boilermakers' work shall consist of laying out, cutting apart, building, or repairing boilers, tanks, and drums; inspecting, patching, riveting, chipping, calking, flanging, and flue work; building, repairing, removing and applying steel cabs and running boards; laying out and fitting up any sheet-iron or sheet-steel work made of 16 gage or heavier (present practice between boilermakers and sheet-metal workers to continue relative to gage of iron), including fronts and doors; ash pans, front end netting and diaphragm work, engine tender steel underframe and pressed

steel tender truck frames, except where other mechanics perform this work; removing and applying all stay bolts, radials, flexible caps, sleeves, crown bolts, stay rods, and braces in boilers, tanks and drums; applying and removing arch tubes; operating punches and shears for shaping and forming, pneumatic stay-bolt breakers, air rams and hammers; bull, jam, and yoke riveters; boilermakers' work in connection with building and repairing of steam shovels, derricks, booms, housing, circles, and coal buggies, I-beam, channel iron, angle iron, and T-iron work; all drilling, cutting and tapping and operating rolls in connection with boilermakers' work; oxyacetylene, thermit, and electric welding on work generally recognized as boilermakers' work, and all other work generally recognized as boilermakers' work. It is understood that present practice in the performance of work between boilermakers and carmen will continue. On running repairs, boilermakers may connect or disconnect any wiring, coupling or pipe connections necessary to make or repair machinery or equipment.

This rule shall not be construed to prevent engineers, firemen and cranemen on steam shovels, ditchers, clam shells, wrecking outfits, pile drivers and other similar equipment requiring repairs on line of road, from making any repairs to such equipment as they are qualified to perform.

Boilermaker Apprentices

Rule 80—Include regular and helper apprentices in connection with the work as defined by rule 79.

Boilermaker Helpers

Rule 81—Employees assigned to help boilermakers and their apprentices, operators of drill presses, and bolt cutters in the boiler shop, boiler washers, punch and shear operators (cutting only bar stock and scrap), and employees removing and applying grates and grate rigging, and all other work properly recognized as boilermaker helpers' work.

Running-repair Work

Rule 82—Boilermakers assigned to running repairs may be used to perform other work.

Boilermakers assigned to locomotive general repair work may be used to perform running-repair work when the regular assigned running-repair forces are unable to get engines out to meet service requirements.

Boilermakers who have been working on hot work will not be required to work on cold work until given sufficient time to cool off.

Special Services

Rule 83—Flange turners, layer outs, and fitter ups shall be assigned in shops where flue sheets and half side sheets or fire boxes are flanged, removed, and applied. One man may perform all these operations where the service does not require more than one man. If not fully engaged on the above work, these employees may be assigned to any work of their craft.

Boiler inspectors—stay-bolt inspectors will be assigned to all points where monthly stay-bolt and boiler inspection of 15 or more engines is required. When such employees have no inspection work to perform, they may be assigned to other boilermakers' work.

Protection for Employees

Rule 84—Boilermakers, apprentices and helpers will not be required to work on boilers or tanks while electric or other welding processes are in use or when tires are being heated, unless proper protection is provided.

Rule 85—Not more than one oxyacetylene welding or cutting operator or electric operator will be required to work in firebox or shell of boiler at the same time, unless proper protection is provided.

Rule 86—Oxyacetylene welding or cutting operator or electric operator will be furnished with helper when necessary, or when it is essential for personal safety.

Rule 87—Should it become necessary to send oxyacetylene welder or cutter or electric operator out of the shop in cold weather, he will be given ample time to dry off before being sent out.

Rule 88—When it is necessary to renew, remove, or replace flue, door, side, or crown sheets by means of oxyacetylene or other cutting or welding processes, such portion of the ash-pan wings and grates as interfere with the operator, will be removed. Dome caps will be removed and front ends opened up if required, for proper ventilation.

Rule 89—Boilers will have steam blown off and be reasonably cooled before boilermakers or apprentices are required to work in them; blowers will be furnished when possible to do so.

Fireboxes, front ends, and ash pans will be properly cleaned out before boilermakers or apprentices are required to work in them. Fire brick interfering with the work to be performed will be removed.

Rule 90—Two boilermakers, or one boilermaker and a competent apprentice with at least two years' experience, will be used to operate a long-stroke hammer, that is, an air hammer capable of driving stay bolts or rivets five-eighths inch diameter or larger, or of expanding flues or tubes. Double-gun work will not be permitted. Air jacks not to be considered double guns.

When rolling or expanding superheater flues, two boilermakers, or one boilermaker and a competent apprentice with at least two years' experience, will be used.

Rule 91—No tapping or reaming will be done in fireboxes when same is near enough to endanger the men working on inside of firebox. A space of 10 rows of stay bolts will be considered sufficient, it being understood that the helper will protect the men with a sleeve over a tap when tapping is being done.

Furnishing Help

Rule 92—Boilermakers engaged on running-repair work will be furnished a helper when necessary, or when it is essential for personal safety.

Rule 93—Boilermakers sent out on the road to do boilermakers' work will have helper furnished when necessary.

Removal of Flues

Rule 94—When flues (other than burst flues) are to be removed, the front end will be opened and such parts of the draft appliances as interfere with the boilermaker will be removed. Center arch pipes in engine, other than those equipped with combustion chambers, which interfere with boilermakers in the performance of their work, will be removed.

Helpers on Flange Fires

Rule 95—Regular assigned help will be furnished on flange fires.

Rule 96—Helpers on flange fires will not be asked to go outside of shop to handle fuel during cold weather.

Rule 97—Eliminated.

Helpers

Rule 98—There will be sufficient help furnished boilermakers or apprentices in breaking down stay bolts with hand ram.

Rule 99—Eliminated.

Rule 100—Holding on all stay bolts and rivets, striking chisel bars, side sets, and backing out punches, and heating rivets (except when performed by apprentices) will be considered boilermaker helpers' work.

Rule 101—When rivets are to be cut off or backed out, a barrier or sufficient help will be furnished to prevent accidents or personal injury.

Rule 102—Boilermakers or apprentices when using compound motors will be furnished sufficient competent help.

Rule 103—Sufficient help will be furnished when holding on rivets with wedge bars.

Rule 104—Included in rule 81.

Helper Apprentices

Rule 105—Fifty per cent of the apprentices may consist of boilermaker helpers who have had not less than two consecutive years' experience as boilermaker helper at the point where employed at the time application for apprenticeship is made.

They shall be between the ages of 21 and 40 years and shall serve three years, a minimum of 290 days each calendar year.

Helper apprentices shall be governed by the same laws and rules as regular apprentices.

Apprentices shall not work on oxyacetylene, thermit, electric, or other welding processes until they are in their last year.

They shall receive the minimum helpers' rate for the first six months, with an increase of two cents per hour for every six months thereafter until they have served their apprenticeship.

Schedule of Work, Regular Apprentices

Rule 106—The following schedule for regular apprentices showing the division of time on the various classes of work is designed as a guide and will be followed as closely as the conditions will permit:

Six months—Heating rivets and helping boilermakers.
Six months—Tank repairing and sheet-iron work.
Six months—Rolling flues; ash-pan work.
Six months—Stay bolts and setting flues.
Fifteen months—General boiler work.
Three months—Electric or oxyacetylene welding.
Six months—Laying out and flanging.

Schedule of Work, Helper Apprentices

Rule 107—The following schedule for helper apprentices showing the division of time on the various classes of work is designed as a guide and will be followed as closely as the conditions will permit:

Six months—Tank repairing and sheet-iron work.
Six months—Rolling flues; ash-pan work.
Six months—Stay bolts and setting flues.
Nine months—General boiler work.
Three months—Electric or oxyacetylene welding.
Six months—Laying out and flanging.

Differentials for Boilermakers

Rule 108—Boilermakers assigned as boiler inspectors, also flangers, layer outs, and autogenous welders shall receive five cents per hour above the minimum rate paid boilermakers at the point employed.

At points or on shifts where no inspector is assigned and boilermakers are required to inspect boilers, they will be paid five cents per hour above the boilermakers' minimum rate at the point employed for the days on which such inspections are made.

Rule 109—Helpers on flange fires shall receive five cents per hour above the helpers' rate at point employed.

Blacksmiths' Special Rules

Qualifications

Rule 110—Any man who has served an apprenticeship or who has had four years' varied experience at the blacksmiths' trade shall be considered a blacksmith. He must be able to take a piece of work pertaining to his class and, with or without the aid of drawings, bring it to a successful completion within a reasonable length of time.

Classification of Work

Rule 111—Blacksmiths' work shall consist of welding, forging, heating, shaping, and bending of metal; tool dressing and tempering, springmaking, tempering and repairing, potashing, case and bichloride hardening; flue welding under blacksmith's foreman; operating furnaces, bulldozers, forging machines, drop-forging machines, bolt machines, and Bradley hammers;

hammersmiths, drop-hammermen, trimmers, rolling mill operators; operating punches and shears doing shaping and forming in connection with blacksmiths' work; oxyacetylene, thermit and electric welding on work generally recognized as blacksmiths' work, and all other work generally recognized as blacksmiths' work.

Blacksmith Apprentices

Rule 112—Include regular and helper apprentices in connection with the work as defined by rule 111.

Blacksmith Helpers

Rule 113—Helpers' work shall consist of helping blacksmiths, and apprentices, heating, operating steam hammers, punches and shears (cutting only bar stock and scrap), drill presses and bolt cutters; straightening old bolts and rods, cold; building fires; lighting furnaces, and all other work properly recognized as blacksmith helpers' work.

Helper Apprentices

Rule 114—Fifty per cent of the apprentices may consist of helpers who have had not less than two consecutive years' experience in shop on the division where advanced.

Seniority shall prevail in the selection of helper apprentices; those selected to be not over 30 years of age.

Apprentices selected from helpers shall serve three years, a minimum of 290 days each calendar year. When started as an apprentice they shall receive the minimum helpers' rate of pay for the first six months; at the end of that time they shall receive two cents per hour increase, and two cents per hour increase each succeeding six months while serving their apprenticeship.

Helper apprentices shall be governed by the same laws and rules as regular apprentices.

If after the first three months they show no aptitude to learn the trade, they shall be set back to helping and retain their former seniority as a helper.

After completing their apprenticeship they shall receive prevailing rate paid blacksmiths if retained in the service.

Apprentices, Miscellaneous

Rule 115—Apprentices shall be given an opportunity to learn all branches of the trade and will not be kept on any one class of work longer than four months. Apprentices shall not work on oxyacetylene, thermit, electric, or other welding processes until they are in their last year.

Rule 116—Eliminated.

Helpers Building Fires

Rule 117—Blacksmith helpers required to prepare or build coal or coke fires outside their regular working hours, shall be allowed thirty minutes straight time for each fire built or furnace prepared. Helpers assigned to start oil or gas furnaces outside their regular working hours will receive one and one-half time for such service, on the minute basis.

Rule 118—Eliminated.

Coal and Oil to Be Furnished

Rule 120—Coal and oil suitable for smithing purposes will be furnished whenever possible.

Steam-hammer Operators

Rule 121—Competent steam-hammer operators will be furnished.

Road Work

Rule 122—Blacksmiths sent out on the road to do blacksmiths' work will be accompanied by helper when necessary.

Rule 123—Included in Rule 113.

Sheet-Metal Workers' Special Rules

Qualifications

Rule 125—Any man who has served an apprenticeship, or has had four or more years' experience at the various branches of the trade, who is qualified and capable of doing sheet-metal work or pipe work as applied to buildings, machinery, locomotives, cars, et cetera, whether it be tin, sheet iron, or sheet copper, and capable of bending, fitting and brazing of pipe, shall constitute a sheet-metal worker.

Classification of Work

Rule 126—Sheet-metal workers' work shall consist of tinning, coppersmithing and pipefitting in shops, yards, buildings, on passengers coaches and engines of all kinds; the building, erecting, assembling, installing, dismantling (for repairs only), and maintaining parts made of sheet copper, brass, tin, zinc, white metal, lead, black, planished, pickled and galvanized iron of 10 gage and lighter (present practice between sheet-metal workers and boilermakers to continue relative to gage of iron), including brazing, soldering, tinning, leading, and babbitting (except car and tender truck journal bearings), the bending, fitting, cutting, threading, brazing, connecting and disconnecting of air, water, gas, oil and steam-pipes; the operation of babbitt fires (in connection with sheet-metal workers' work); oxyacetylene, thermit and electric welding on work generally recognized as sheet-metal workers' work, and all other work generally recognized as sheet-metal workers' work.

In running repairs, other mechanics than sheet-metal workers may remove and replace jackets, and connect and disconnect pipes where no repairs are necessary to the jackets or pipes in question.

Sheet-metal Worker Apprentices

Rule 127—Include regular and helper apprentices in connection with the work as sheet-metal workers' helpers.

Sheet-metal Worker Helpers

Rule 128—Employees regularly assigned as helpers to assist sheet-metal workers and apprentices in their various classifications of work, shall be known as sheet-metal workers' helpers.

Protection for Employees

Rule 129—Sheet-metal workers shall not be required to remove or apply blow-off or surface pipes or ash-pan blowers on boilers under steam.

Road Work

Rule 130—Sheet-metal workers will be sent out on line of road and to outlying points, when their services are required, but not for small, unimportant running-repair jobs.

Assignment of Running-repair Force to Dead Work

Rule 131—Sheet-metal workers assigned to running repairs shall not be required to work on dead work at points where dead-work forces are maintained, except when there is not sufficient running repairs to keep them busy.

Assignment of Dead-work Force to Running Repairs

Rule 132—Dead-work forces will not be assigned to perform running-repair work, except when the regularly assigned running-repair forces are unable to get engines out in time to prevent delay to train movement.

Miscellaneous

Rule 133—Sheet-metal workers will not be assigned to work not applicable to them, except in emergency cases.

Helper Apprentices

Rule 134—Fifty per cent of the apprentices may be selected from helpers of this craft who have had not less than two consecutive years' experence as a sheet-metal-worker helper at the point where employed, and shall not be more than thirty years of age; such apprentice shall serve three calendar years, a minimum of 290 days each calendar year, seniority to govern.

Rule 135—Helper apprentices will start at the third classification of regular apprentices' schedule when entering their apprenticeship, and continue through as regular apprentices. Helper apprentices will receive the minimum helpers' rate for the first six months, with an increase of two cents per hour for every six months thereafter until their have served three years.

Rule 136—Eliminated.

Apprentice Schedule of Work

Rule 137—Regular apprentices' schedule and division of time:

Six months—Helping.

Six Months—Light pipe work.

Twelve months—Tinning, babbitting and brazing, laying out and forming.

Twelve months—Engine and car work.

Twelve months—General work, including one month's experience with the oxyacetylene torch.

Differentials for Sheet-metal Workers

Rule 138—Autogenous welders shall receive five cents per hour above the minimum rate paid sheet-metal workers at point employed.

Electrical Workers' Special Rules

Qualifications

Rule 139—Any man who has served an apprenticeship or who has had four years' practical experience in electrical work and is competent to execute same to a successful conclusion within a reasonable time will be rated as an electrical worker.

An electrician will not necessarily be an armature winder.

Classification of Electricians

Rule 140—Electricians' work shall include electrical wiring, maintaining, repairing, rebuilding, inspecting and installing of all generators, switchboards, meters, motors and controls, rheostats and controls, static and rotary transformers, motor generators, electric headlights and headlight generators, electric welding machines, storage batteries (work to be divided between electricians and helpers as may be agreed upon locally), axle lighting equipment, all inside telegraph and telephone equipment, electric clocks and electric lighting fixtures; winding armatures, fields, magnet coils, rotors, transformers and starting compensators; inside and outside wiring at shops, buildings, yards, and on structures and all conduit work in connection therewith (except outside wiring provided for in rule 141), steam and electric locomotives, passenger train and motor cars, electric tractors and trucks; include cable splicers, high-tension power house and substation operators, high-tension linemen, and all other work properly recognized as electricians' work.

Classification of Linemen, etc.

Rule 141—Linemen's work shall consist of the building, repairing, and maintaining of pole lines and supports for service wires and cables; catenary and monorail conductors; trolley and feed wires, overhead and

underground, together with their supports; maintaining, inspecting, and installing third rail and cables for third rail that carry current to or from third rail and track rail; pipe lines or conduits for these cables; bonding of third rail or cables; all outside wiring in yards, and other work properly recognized as linemen's work not provided for in rule 140.

Signal maintainers who, for 50 per cent or more of their time, perform work as defined in rules 140 and 141.

Men employed as generator attendants, motor attendants (not including water service motors), and substation attendants who start, stop, oil, and keep their equipment clean and change and adjust brushes for the proper running of their equipment; power switchboard operators, coal-pier car dumpers and coal-pier conveyor-car operators in connection with loading and unloading vessels.

This to include operators of electric traveling cranes, capacity 40 tons and over.

Classification of Groundmen, etc.

Rule 142—Groundmen's work shall consist of assisting linemen in their duties, when said work is performed on the ground, but shall not include those who perform common labor in connection with linemen's or groundmen's work. Electric crane operators for cranes of less than 40-ton capacity.

Rule 143—Coal-pier elevator operators and coal-pier electric hoist operators in connection with loading and unloading vessels.

Apprentice Electrical Workers

Rule 144—Include regular and helper apprentices in connection with electrical workers.

Electrical Worker Helpers

Rule 145—Employees regularly assigned as helpers to assist electrical workers and apprentices, including electric lamp trimmers who do no mechanical work, also to perform such battery work as may be agreed upon locally as being helpers' work.

Helper Apprentices

Rule 146—Fifty per cent of the apprentices may consist of electrical workers' helpers who have had two years' continuous service at the point where employed. When assigned as helper apprentices, they must not be over 25 years of age, and shall serve three years, a minimum of 290 days each calendar year.

Regular Apprentice Schedule of Work

Rule 147—The following schedule for regular apprentices, showing the division of time on the various classes of work, is designed as a guide and will be followed as closely as possible:

Twelve months—Inside wiring and electrical repairing.
Six months—Outside line work.
Six months—Locomotive headlight work.
Six months—Car lighting department.
Six months—Armature winding.
Twelve months—General electrical work.

Helper Apprentice Schedule of Work

Rule 148—Helper apprentices will receive the minimum helpers' rate for the first six months, with an increase of two cents per hour for every six months thereafter until their apprenticeship is completed. If within six months they show no ability to acquire the trade, they will be set back to helping and retain their former seniority as a helper. After completing their apprenticeship, they shall receive the minimum rate paid for the work to which they are assigned, if retained in the service.

Rule 149—The following schedule for helper apprentices, showing the division of time on the various classes of work, is designed as a guide and will be followed as closely as possible.

Six months—Inside wiring and electrical repairing.
Six months—Outside line work.
Six months—Locomotive headlight work.
Six months—Car lighting department.
Six months—Armature winding.
Six months—General electrical work.

Miscellaneous

Rule 150—Laborers or similar class of workmen shall not be permitted to do helpers' work as outlined in rule 145 if regular electrical-worker helpers are available.

Rule 151—Men engaged in the handling of storage batteries and mixing acid must be provided with acid-proof rubber gloves, hip boots, and aprons.

Rule 152—Autogenous welders shall receive five cents per hour above the minimum rate paid electrical workers at point employed.

Carmen's Special Rules

Qualifications

Rule 153—Any man who has served an apprenticeship or who has had four years' practical experience at car work, and who with the aid of tools, with or without drawings, can lay out, build, or perform the work of his craft or occupation in a mechanical manner, shall constitute a carman.

Classification of Work

Rule 154—Carmen's work shall consist of building, maintaining, dismantling (except all-wood freight-train cars), painting, upholstering and inspecting all passenger and freight cars, both wood and steel, planing mill, cabinet and bench carpenter work, pattern and flask making and all other carpenter work in shops and yards, except work generally recognized as bridge and building department work; carmen's work in building and repairing motor cars, lever cars, hand cars and station trucks, building, repairing and removing and applying locomotive cabs, pilots, pilot beams, running boards, foot and headlight boards, tender frames and trucks; pipe and inspection work in connection with air brake equipment on freight cars; applying patented metal roofing; operating punches and shears, doing shaping and forming; work done with hand forges and heating torches in connection with carmen's work; painting with brushes, varnishing, surfacing, decorating, lettering, cutting of stencils and removing paint (not including use of sand blast machine or removing in vats); all other work generally recognized as painters' work under the supervision of the locomotive and car departments, except the application of blacking to fire and smoke boxes of locomotives in engine houses; joint car inspectors, car inspectors, safety appliance and train car repairers; oxyacetylene, thermit and electric welding on work generally recognized as carmen's work; and all other work generally recognized as carmen's work.

It is understood that present practice in the performance of work between the carmen and boilermakers will continue.

Carmen Apprentices

Rule 155—Include regular and helper apprentices in connection with the work as defined by rule 154.

Carmen Helpers

Rule 156—Employees regularly assigned to help carmen and apprentices, employees engaged in washing and scrubbing the inside and outside of passenger coaches preparatory to painting, removing of paint on other than passenger cars preparatory to painting, car oilers and packers, stock keepers (car department), operators of bolt threaders, nut tappers, drill presses, and punch and shear operators (cutting only bar stock and scrap), holding on rivets, striking chisel bars, side sets, and backing out punches, using backing hammer and sledges in assisting carmen in straightening metal parts of cars, rebrassing of cars in connection with oilers' duties, cleaning journals, repairing steam and air hose, assisting carmen in erecting scaffolds, and all other work generally recognized as carmen's helpers' work, shall be classed as helpers.

Wrecking Crews

Rule 157—Regularly assigned wrecking crews, not including engineers, will be composed of carmen, where sufficient men are available, and will be paid for such service under rule 10, Decision No. 222. Meals and lodging will be provided by the company while crews are on duty in wrecking service.

When needed, men of any class may be taken as additional members of wrecking crews to perform duties consistent with their classification.

Rule 158—When wrecking crews are called for wrecks or derailments outside of yard limits, a sufficient number of the regularly assigned crew will accompany the outfit. For wrecks or derailments within yard limits, sufficient carmen will be called to perform the work.

Inspectors

Rule 159—Men assigned to inspecting must be able to speak and write the English language, and have a fair knowledge of the A. R. A. (American Railway Association) rules and safety appliance laws.

Rule 160—Inspectors and other carmen in train yards will not be required to take record, for conducting transportation purposes, of seals, commodities, or destination of cars where record clerks, yardmasters, agents or yard clerks are employed.

Safety Appliance Men

Rule 161—Men assigned to follow inspectors in yards to make safety appliance and light running repairs, shall not be required to work on cars taken from trains to repair tracks, except when there is not sufficient work in train yards to fully occupy their time.

Protection for Repairmen

Rule 162—Switches of repair tracks will be kept locked with special locks and men working on such tracks shall be notified before any switching is done. A competent person will be regularly assigned to perform this duty and held responsible for seeing that it is performed properly.

Rule 163—Trains or cars while being inspected or worked on by train yard men will be protected by blue flag by day and blue light by night, which will not be removed except by men who place same.

Miscellaneous

Rule 165—Air hammers, jacks, and all other power driven machinery and tools, operated by carmen or their apprentices, will be furnished by the company and maintained in safe working condition.

Rule 166—Crayons, soapstone, marking pencils, tool handles, saw files, motor bits, brace bits, cold chisels, bars, steel wrenches, steel sledges, hammers (not claw hammers), reamers, drills, taps, dies and lettering and striping pencils and brushes will be furnished by the company.

Rule 167—Included in rule 154.

Rule 168—When necessary to repair cars on the road or away from the shops, carman, and helper when necessary, will be sent out to perform such work as putting in couplers, draft rods, draft timbers, arch bars, center pins, putting cars on center, truss rods, and wheels, and work of similar character.

Rule 169—Shops, repair yards, and train yards, where carmen are employed, shall be kept clean of all rubbish.

Apprentices

Rule 170—Regular apprenticeships will be established in all branches of the trade. Apprentices shall be governed by the general rules covering apprentices.

Rule 171—Apprentices shall not work on oxyacetylene, thermit, electric, or other welding processes until they are in their last year.

Helper Apprentices

Rule 172—Fifty per cent of the apprentices may be selected from carmen's helpers who have had not less than two consecutive years' experience at the point employed at the time application for apprenticeship is made.

Helper apprentices shall not be over 30 years of age and will serve three years, a minimum of 290 days each calendar year.

Helper apprentices shall be governed by the same laws and rules as regular apprentices.

Helper apprentices shall receive the minimum helpers' rate for the first six months, with an increase of two cents per hour each succeeding six months until they have served three years. At the completion of their apprenticeship period, if retained in the service, they shall receive the mechanics' rate of pay.

Painter Apprentices, Regular

Rule 173—Regular apprentices—Division of time for painter apprentices: The following schedule for regular apprentices, painter, showing the division of time on the various classes of work, is designed as a guide and will be followed as closely as the conditions will permit:

Six months—Freight-car painting.
Six months—Color room, mixing paint.
Six months—General locomotive painting.
Twelve months—Brush work, passenger equipment.
Eighteen months—Lettering, striping, varnishing, and such laying out and designing as the shop affords.

Schedule of Work, Painter Helper Apprentices

Rule 174—Helper apprentices—Division of time for painter apprentices: The following schedule for helper apprentices, painter, showing the division of time on the various classes of work, is designed as a guide and will be followed as closely as the conditions will permit:

Four months—Freight-car painting.
Four months—Color room, mixing paint.
Four months—General locomotive painting.
Ten months—Brush work, passenger equipment.
Fourteen months—Lettering, striping, varnishing, and such laying out and designing as the shop affords.

Regular Apprentices, Carmen Schedule of Work

Rule 175—The following schedule for regular apprentices, showing the division of time on the various classes of work, is designed as a guide and will be followed as closely as the conditions will permit. Where sufficient passenger car department work is not available without exceeding the regular ratio of apprentices in the passenger car department, apprentices will complete their apprenticeship in the freight car department:

Eighteen months—General freight work, wood and steel.
Six months—Air-brake work.
Six months—Mill machine work.
Eighteen months—General coach work, wood and steel.

Helper Apprentice, Carmen Schedule of Work

Rule 176—The following schedule for helper apprentices, showing the division of time on the various classes of work, is designed as a guide and will be followed as closely as the conditions will permit. Where sufficient passenger car department work is not available without exceeding the regular ratio of apprentices in the passenger car department, apprentices will complete their apprenticeship in the freight car department.

Twelve months—General freight work, wood and steel.
Six months—Air-brake work.
Six months—Mill machine work.
Twelve months—General coach work, wood and steel.

Rule 177—In the event of not being able to employ carmen with four years' experience, regular and helper apprentices will be advanced to carmen in accordance with their seniority. If more men are needed helpers will be promoted. If this does not provide sufficient men to do the work, men who have had experience in the use of tools may be employed. They will not be retained in service when four-year carmen become available.

Note:—Helpers advanced as above will retain their seniority as helpers.

Differentials for Carmen

Rule 178—Autogenous welders shall receive five cents per hour above the minimum rate paid carmen at point employed.

Coach Cleaners

Rule 179—Coach cleaners to be included in this agreement and will receive overtime as provided herein. Coach cleaners at outlying points may be worked eight hours within a period of ten consecutive hours. They may be assigned to any other unskilled work during their eight-hour period of service.

Miscellaneous

Scope of General and Special Rules

Rule 180—Except as provided for under the special rules of each craft, the general rules shall govern.

Rule 181—Eliminated.

Rule 182—Eliminated.

Revision of Agreement

Rule 183—Should either of the parties to this agreement desire to revise or modify these rules, 30 days' written advance notice, containing the proposed changes, shall be given and conferences shall be held immediately on the expiration of said notice unless another date is mutually agreed upon.

Rule 184—Eliminated.

Rule 185—This agreement shall be effective as provided in the several decisions of the United States Railroad Labor Board hereon and shall continue in effect until it is changed as provided for in rule 183 or under the provisions of the Transportation Act, 1920.

Rule 186—Eliminated.

General Instructions

Sec. 1—Application of Adopted Rules

The rules approved by the Labor Board shall apply to each of the carriers parties to the dispute in Docket 475 (Decision No. 222 and addenda thereto), except in such instances as any particular carrier may have agreed with its employees upon any one or more of such rules, in which case the rule or rules agreed upon by the carrier and its employees shall apply on said road.

Sec. 2—Disposition of Eliminated Rules

The rules eliminated by the Labor Board shall cease and terminate, except in such instances as any particular carrier may have agreed with its employees upon any one or more of such rules, in which case the rule or rules agreed upon by the carrier and its employees shall apply on said road.

Sec. 3—Formulation of Preamble or Caption

The formulation of a preamble or caption to agreements or contracts is hereby remanded to the carriers and their employees, severally, and in connection therewith the parties are referred to Decision No. 205, issued by the Labor Board.

Sec. 4—Disposition of Omitted Rules

The Labor Board believes that certain subject matters now regulated by the rules of the national agreement may not be covered in all localities by rules of general application, and require further consideration by the parties directly concerned. The rules governing these matters are indicated herein by the omission of any reference to the numbers thereof as used in the national agreement, and all such rules which involve a dispute between a particular carrier and its employees are hereby remanded to said carrier and its employees for the purpose of adjustment under the provisions of Section 301 of the Transportation Act, 1920.

Sec. 5—Interpretation of This Decision

The rules herein adopted, where similar to the rules in the so-called national agreement, are not to be understood or construed as carrying with them the interpretations placed on same by the United States Railroad Administration, by the adjustment boards or by other agencies acting under said administration, but are to be considered and construed as new rules adopted by the Labor Board in accordance with the Transportation Act, 1920, and the principles announced in Decision No. 119.

Should a dispute arise between the management and the employees of any of the carriers as to the meaning or intent of this decision which cannot be decided in conference between the parties directly interested, such dispute shall be handled in the manner provided by the Transportation Act, 1920.

A Novel Explanation of a Locomotive Boiler Explosion

On November 11 a locomotive on the London & Northwestern Railway of England burst at Buxton. The driver and fireman were killed and there was considerable damage to property. E. R. Calthrop, commenting on the explosion in The Engineer (London), suggests that the cause of the unusual severity of the explosion may be found in the spheroidal state of boiling water, in which condition shock or vibration can convert the whole mass of water instantly into an equivalent volume of steam.

Mr. Calthrop calls attention to the fact that it is hardly conceivable that there should have been any defect in the safety valve or any negligence on the part of the engineer or fireman. The complete destruction of the engine indicated an explosion of extraordinary intensity, resembling what would be expected as a result of the explosion of a charge of dynamite placed in the position occupied by the boiler. It would seem that this explosion has many points in common with the extraordinary explosion that occurred at San Antonio, Tex., several years ago.

Meeting of Railroad Division of A. S. M. E.

Papers on Elimination of Waste in Design of Motive Power and in Operation of Locomotives and Cars

THE elimination of waste in industry was the general topic discussed at the annual meeting of the American Society of Mechanical Engineers held in New York the week of December 5. In conformity with this subject, the Railroad Division of the society, at its meeting on December 6, presented two papers on avoidable waste in locomotives and cars of special interest to men in the mechanical department. The first of these papers, by James Partington, on Avoidable Waste in Locomotives as Affected by Design, was published in the *Railway Mechanical Engineer* of November, 1921, page 673. Discussion of Mr. Partington's paper and the second paper, by W. C. Sanders appears below.

Avoidable Waste in Car Operation—The Container Car

By Walter C. Sanders

The container car was an outcome of the railroad congestion during the war and was first put in operation last year by A. H. Smith, president of the New York Central Lines, to reduce the transportation losses due to congestion which tied up industry. It is hoped that mail, express and freight robberies, breakage, checking and rehandling, delays to shippers, and many other railroad evils may also be materially reduced by the container-car system.

Loss of and damage to freight has grown in recent years into one of the heaviest leaks in the transportation industry

Freight Type Container Loaded on a Motor Truck. The Larger Containers Which Originally Formed Part of the Equipment Are No Longer Used, the Size Shown Being Standard

and strenuous campaigns which included maintenance of extensive police and supervisory forces, together with educational campaigns among shippers and railroad employees to secure stronger packing, careful handling and suppression of theft, have failed to stop this economic waste.

The proportions of this tranportation problem may be judged from the fact that in the year 1914 American railroads paid out $33,000,000 in claims for loss of and damage to freight, and for the year 1920 this amounted to a total of $125,000,000, the incidental injury to business affected being considerably greater. Under the ordinary system of handling less-than-carload lots or shipments the goods are checked and handled item by item from shipper to truck or dray, from truck to depot platform or warehouse, and from the platform to the car. They are subject to handling and checking at each stage of the journey, and when finally they reach their destination this handling and checking is all done over again. It is therefore necessary to maintain armies of employees to act as freight handlers, clerks, checkers and station overseers, as well as switchmen to shunt cars to fixed locations where loading and unloading are possible.

The container system provides that the portable container shall be loaded and locked at the shipper's own store door, conveyed by motor truck to the railroad yard, and lifted by crane aboard the container car, where steel bulkheads and sides form absolute protection against opening the container in transit. At the destination the locked container is unloaded by a crane and carried by motor truck directly to the warehouse or consignee's door, to be unloaded at his convenience. This simple system of handling goods will make it possible to greatly reduce the force of employees now necessary.

Another advantage of the container-car system expected to prove most valuable is the greatly increased use of container rolling stock in moving service, which is particularly important when traffic expands to its peak and when the prime need is to shorten layovers of cars in yards and stations for loading and unloading, and to limit their idleness and obstruction through misuse for storage purposes. In busy times the need is to keep every wheel turning as continuously as possible to secure maximum transportation. With ample supplies of the removable containers, which in their several classes are of uniform size and interchangeable, one carload of containers may be removed and sent with their loads to consignees, and another set immediately hoisted into place and the car be ready to proceed within a matter of minutes in most instances. The locked containers may remain on station platforms or at the stores of shippers for loading or unloading at convenience without tying up costly rolling stock at points where track capacity is limited and congestion quickly obstructs the flow of traffic unless the cars are kept moving. With this rapid handling of the containers on and off the car the mileage per year made by the ordinary piece of rolling stock may be doubled, and it is predicted that the tremendous expense of maintaining box cars and other rolling stock equal to all emergencies will be materially cut down.

The container car may make costly packing and crating unnecessary because goods packed in flimsy pasteboard boxes or even bound with heavy paper are protected against breakage, theft, and water or weather damage.

There are at present in service on the New York Central Lines three container cars, one of the mail or express type, and two that are being used for valuable freight, such as silks and woolens. Three new mail cars of improved design

which are now being constructed will be equipped with an improved type of all-steel container. A new freight-type container car is being designed, and refrigerator and tank container cars are contemplated.

General Description of the Container Car

The container car is nothing more than a long car with a steel side or fence, similar to a low-side gondola, loaded with large steel safes or containers, made as light as possible, in which commodities of all kinds travel from consignor to consignee, inviolate against thieves, fire, weather and breakage. The safes or containers are lifted on and off the car by cranes or hoisting devices, permitting the "parent" rolling stock to continue in transportation circulation.

[Mr. Sanders' paper included a detailed description of the express container cars as illustrated and described in the *Railway Mechanical Engineer* for March, 1921, page 171, and the freight container cars.—Editor.]

Containers and Container Cars Now Under Construction

The three new mail-type container cars now being built will carry eight containers of a new, improved design, the outside measurements being, length 7 ft. 2½ in., width 9 ft. 3½ in., clear height 8 ft. 2 in., with 5 ft. 9 in. by 3 ft. 6 in. door on the length side. The cubic capacity will be 438 cu. ft., light weight 3,000 lb. and capacity 7,000 lb.

Tests conducted in the last few months on the New York Central Lines have demonstrated that the express type of container car can be emptied of the nine containers by an ordinary crane in 21 min. and reloaded with other containers and the car put back in circulation in about the same time. This test was made with an ordinary moving track crane, since no special cranes or handling devices have as yet been constructed for use in handling the containers. With the special handling devices contemplated it will be possible to unload the containers with greater speed directly to waiting motor trucks, platforms, or on the ground.

During May, 1921, at the request of the Postmaster General, a mail test was run from New York City to Chicago, Ill., and return with the express type of container car. Upon arrival at Chicago the nine containers, containing 37,000 lb. of mail, were unloaded onto waiting Post Office motor trucks in 21 min., which is one-fifth of the time used in unloading an ordinary mail storage car. At Chicago connections were made with western mail trains that have never been made before. Upon the arrival at New York on the return trip the containers were removed from the car in 18 min.

It is believed that the use of containers in mail service (1) will prevent the loss in transit of valuable registered mail, parcels post and other mail; (2) will mean a saving to the government in handling mail, both in trucking and checking as well as a material saving to the railroads in the use of equipment; (3) will make possible a quick transfer at important gateway points and the maintaining of close railway connections otherwise impossible; and (4) will afford an increased weight and capacity as compared with the average load now handled in mail storage or baggage cars, the average weight of mail now carried in mail storage cars being approximately 30,000 lb.; 37,000 lb. of mail were carried on the run to Chicago.

Summary

A summary of prime advantages of the container car system is as follows:

(*a*) It will furnish a means of expediting delivery of less-than-carload lots of commodities by eliminating the time and expense of rehandling, checking and trucking.

(*b*) It will eliminate costly crating and packing.

(*c*) The immediate unloading and loading of containers at terminal points eliminates the item of demurrage, at the same time promptly releasing rolling stock, clearing the yards of cars and reducing congestion.

(*d*) It will eliminate the piecemeal loading of cars at railway sidings in exposure to all kinds of weather.

(*e*) It will tend to keep the car moving at all times, making possible double the mileage as made now by an ordinary piece of rolling stock.

(*f*) Containers are fire- and weather-proof, and also burglar-proof in that they cannot be opened while on the car or while being transferred by handling devices to and from the car.

The increased service capacity of each unit by the development of the container-car system is thought to hold far-reaching economic possibilities in railroad operations of the future, as well as in the co-ordinated use of the motor truck and the electric railway.

Discussion

R. H. Newcomb (Boston & Maine), told of experiments with container cars manufactured by the River and Rail Transportation Company on the Boston and Maine. This design differs from the container car described by Mr. Sanders in that the containers can be transferred from the car to motor trucks without the use of cranes or other lifting devices. The container method of transportation seems particularly well adapted for use on the railroads in New England and it was thought that by this system less than carload freight could be handled with one-third the number of cars now used. Replying to questions, Mr. Newcomb stated that no trouble was encountered due to containers freezing to the car underframe in winter and no difficulty was experienced in meeting the requirements of the Safety Appliance Act.

A. E. Ostrander (American Car & Foundry Company), brought out the fact that high-grade commodities, such as furniture, were frequently shipped in the bodies of vans which were removed from the running gear and loaded onto freight cars. The container car affords a much better method of handling such traffic which should be advantageous to the railroads and also to the shippers. The container method of transportation should open up to the railroads a profitable traffic field in the handling of raw and finished silks which are now shipped principally by auto truck.

Representatives of the railway mail service emphasized the value of the container car in expediting the delivery of mail and in handling parcel post matter.

F. S. Gallagher (New York Central) stated that the application of the container system to the transportation of milk was now being considered. By using suitable insulation around the tanks, no icing in transit would be required.

Discussion of Paper by James Partington

The discussion of the paper on Avoidable Waste in Locomotives as Affected by Their Design, by James Partington, published in the *Railway Mechanical Engineer* of November, 1921, page 673, brought out some striking suggestions for modifications in the design and types of motive power as the following extracts from the discussion will show:

John L. Nicholson (Locomotive Firebox Co.): Among the newly developed locomotive attachments that make for increased efficiency and economy the thermic syphon may be mentioned, by reason of its already ascertained influence over the avoidable waste in locomotive design and operation. On all tests made thus far the thermic syphon has never failed to reduce the amount of fuel consumed per drawbar horsepower. In some cases the installation of these syphons

has resulted in a 25 per cent fuel saving. An average saving of 15 to 19 per cent is now well established.

The second efficiency requirement proposed by Mr. Partington is that a drawbar horsepower be produced for the minimum amount of weight of locomotive and tender.

Locomotive 50000 was built back in 1910; and Mr. Partington therefore refers to a number of newly developed attachments which make for increased efficiency and economy. Along with these the thermic syphon, also of fairly recent development, should be considered. Indeed, consideration of thermic syphons, as if applied to locomotive 50000, will at once demonstrate the fundamental character of the improvement which the thermic syphon has accomplished in locomotive design. I will assume that the boiler horsepower of this locomotive is 2250 as stated in the paper. I have also assumed that all of Mr. Partington's figures relating to boiler horsepower are based upon the formulas devised by F. J. Cole of the American Locomotive Company and have used this method in estimating the capacity increasing ability of the thermic syphon; although, over and beyond the increase brought about by the addition of radiant heat absorbing surface in the firebox, consideration must be given the very rapid circulation which the syphons impart to all the water in the boiler, and the effect which this circulation has in further increasing the capacity of the boiler.

The thermic syphon is an inverted triangular water leg that is positioned vertically above the fire in the firebox, and which by thermal action draws water from the throat and barrel of the boiler, and discharges it through and above the crown sheet of the firebox. Thereby the firebox heating surface is much increased and a vigorous fore-and-aft circulation of boiler water is set up. Both factors contribute to a marked increase of capacity, as well as economy.

If two syphons were applied to locomotive 50000 they would add approximately 62 sq. ft. to the radiant heat absorbing surface of the firebox. The effect of this installation would be to add 164 boiler horsepower to the capacity of the locomotive, although I again desire to emphasize the point that this is, at best, a theoretical approximation which in actual practice is far exceeded due to the improved circulation effected throughout the entire boiler.

Allowing for the net additional weight of the syphons, the result of such installation in locomotive 50000 would be to reduce the weight of this locomotive to 113 lb. per boiler horsepower as compared with 119.6 pounds without syphons.

Further in the case of locomotive 50000, the application of thermic syphons as described would increase the boiler horsepower to 100 per cent of the cylinder horsepower. This increase in boiler capacity is alone sufficient to insure a substantial improvement in fuel economy.

Let us see what thermic syphons have actually contributed toward the elimination of avoidable waste in recent locomotive construction. For an example, consider the Mountain type locomotives which were constructed by the American Locomotive Company for the Chicago, Rock Island and Pacific last year. These locomotives are each equipped with three syphons and have a calculated boiler horsepower of 2,855. Without syphons the capacity of these boilers would be reduced to 2,550 horsepower. As these locomotives weigh 369,000 lb., their weight with syphons is 129.3 lb. per boiler horsepower, while without syphons, their weight would be increased to 144.7 lb. per boiler horsepower.

Clearly, this is an instance of a most practical avoidance of waste in locomotive design. Moreover, it is obvious that by employing syphons in these locomotives, the railroads also eliminated avoidable waste in first cost, besides securing a more efficient locomotive that will continue to eliminate waste of fuel and upkeep every day that it is operated. The only conclusion that can be drawn from the foregoing is that locomotives built or operated without syphons must now be taken as representing avoidable wastes, from the standpoints of both fuel economy and unnecessary weight. An examination of the actual facts will convince anyone that syphon maintenance is a negligible factor; and further, that the syphon affords a potential safeguard against disastrous boiler explosions. Already 26 railroads have ordered and purchased thermic syphons. There are now more than 300 thermic syphons in actual use and it is a notable fact that to date, syphons have never caused an engine failure.

C .C. Trump (Stumpf Una-Flow Engine Co.): Perhaps many have wondered why the una-flow engine has not been as much used in locomotive as in stationary work where there are now nearly a million horsepower in service here and abroad. The difficulty has been to find room on the present locomotive for cylinders of a proper size on account of tunnel and bridge clearances. From the latest information from Prof. Stumpf, it appears that he has overcome this and other difficulties.

By using the energy in the exhaust steam with an ejector action, he is able to lower the back pressure in the una-flow cylinder by as much as 4 or 5 lb. per sq. in., especially at heavier loads. He is thereby able to reduce both the length and diameter of his una-flow cylinder for a given draw-bar pull. This also applies to booster engines. He also obtains a better and steadier draft on his fire with less losses. He requires a smaller boiler, but a larger superheater because of the reduced temperature of the flue gases.

With a three or four cylinder locomotive he expects still better vacuum and better drawbar horsepower for weight of locomotive and amount of fuel. Tests are now being conducted on locomotives of this type abroad.

With respect to higher pressure steam, it seems to me that the una-flow engine offers promise of remarkable economies. It is probably no use to go above 400 lb. gage with a simple engine. But data we have from Europe recently indicates that 700 to 800 lb. pressure with a compound una-flow engine and well designed condenser, economizer, etc., might well compete in fuel economy and even in simplicity with a Diesel locomotive engine. It would have great advantages over the Diesel in starting torque and traction and in being able to burn any kind of fuel, solid, liquid or powdered.

W. F. Kiesel, Jr. (Pennsylvania System): The paper is of particular interest, due to its presentation of locomotives designed on basic values adopted by different designers, but compared on American Locomotive Company's formulae. Such formulae, being empirical, must be changed from time to time to keep pace with new theories introduced in locomotive design. Even then, they are useful only as a preliminary approximation of desired values.

Mr. Partington refers to 100 per cent maximum steam requirements of the cylinders. On referring to American Locomotive Company's Bulletin 1017, this, for superheater locomotives, is found to be based on a horsepower H. P. = .0229PA, in which P = boiler pressure and A = cylinder area. That formula is reasonably satisfactory, for locomotives having equal cut-off in full gear, but falls short of forming a basis on which to compare a locomotive with 90 per cent cut-off with one having 50 per cent cut-off.

The test of the Decapod locomotive, Class I1S, showed that in full gear, at low speed, the steam per indicated horsepower was 38 per cent less than the steam rate for a locomotive with 90 per cent cut-off. Under average service conditions the saving in steam is at least 15 per cent.

If the empirical formulae are changed to meet cut-off effect, such as obtains in the Pennsylvania System I1S locomotive, some of the values in the second table would be affected. With a saving of steam of 15 per cent, the steam rate, calculated, pound-per-horsepower-hours, which is given as 20.8 would be 17.68 which compares favorably with test results. The best actual test for steam rate per indicated horsepower was 14.9 pounds.

The empirical formulae also fall short for comparison

due to relative freedom of draft, especially in the smokebox which seriously affects size of nozzle and cylinder back pressure. Furthermore, the beneficial effect of large combustion chamber volume has not been clearly demonstrated. The freedom of the draft and large combustion chamber volume greatly affect the maximum boiler horsepower.

The locomotives listed in the first and second columns of table 1 are, respectively, the American Locomotive Company No. 50000, and the Pennsylvania System Class K4S. The test results for these locomotives are as follows:

	No. 50000	K4S
Low rate, one test, coal lb. per I. H. P.	2.12	1.52
Low rate, one test, steam lb. per I. H. P.	16.5	14.96
Maximum I. H. P.	2,216	3,184
Weight of locomotive per maximum I. H. P.	121.4	97

This shows that the K4S is actually far ahead of No. 50000 on every count, instead of being inferior as the comparison based on the antiquated empirical formulae would indicate.

Although these figures show the fallacy of empirical formulae in serving as a basis for comparative tabulation, they do not detract from the substance of the matter presented by Mr. Partington, which shows the method of procedure and the strides made in design and construction during the past few years to make the locomotive a truly economical powerplant.

C. J. Mellin (American Locomotive Company) commenting on the discussion by W. F. Kiesel, Jr., pointed out that the formulae used by Mr. Partington are intended for purposes of design and therefore all values have been taken on a very conservative basis. Furthermore, a careful study of locomotive proportions has resulted in an improved design since the formulae were originated, and in practice better results are always obtained than are indicated by the formula.

F. H. C. Coppus (Coppus Engineering and Equipment Company): In my opinion the steam locomotive can be developed to such a high degree of efficiency that its drawbar-horsepower would be so cheap and its capacity increased so that electrification for the sake of economy would be out of the question, at least on a large scale, for some time.

The logical order of locomotive development as far as combustion is concerned should be the following: 1. Mechanically induced draft in the front end. 2. Condensing the exhaust steam and carrying the condensate to the tender. 3. Pumping the hot water from the tender through a waste steam and waste gas heater into the boiler. 4. Under-grate forced draft in the ash pan.

By the carrying out of these developments I look forward with confidence to the reduction of the operating expense of the locomotive to an equivalent of 50 per cent of the present coal consumption. The suggested improvements can be added to all locomotives now in use and at a cost that they will pay for themselves inside of a year.

Elmer A. Sperry discussed the application of the Diesel engine to locomotive service, stating that this is one of the principal problems confronting designers and builders of Diesel engines. The fuel efficiency obtained with the Diesel type of engine is so striking that, in Mr. Sperry's opinion, it is bound to come to the fore. He felt that there was an encouraging outlook for the application of the compound Diesel engine which has recently been developed.

Reconstructing the Pennsylvania L1S Locomotive From a Fragment

By Lawford H. Fry

IN presenting this article the author expresses the hope that it will not be taken too seriously. It is not intended to be an exact treatise on locomotive design, but to call attention to the fact that through all parts of a well proportioned locomotive there must run an ordered harmony which links together such apparently unconnected dimensions as those of the main pin bearing and of the heating surface.

It is said that Cuvier, the famous anatomist, could, from a single prehistoric bone, determine all the characteristics and habits of the animal from which it came. In the dim and far off future when electricity has superseded steam as a motive power and has in its turn passed into the discard will there come, we wonder, some Cuvier of the mechanical world to show his students that from a single locomotive part the type and most of the important dimensions of the engine can be determined? Frankly we don't know whether he will or not, but if he should, we can foretell the lines along which he must work, and it may be interesting and instructive to see how they run. Of course not every part will give the same information, but suppose our fortieth century scientist has unearthed the piece of driving wheel shown as Exhibit A, from which the stroke, the wheel diameter and the dimensions of the main pin can be found. We can imagine that after due measurement and careful calculation his announcement to his class would run as follows:

"Gentlemen, the ancient fragment before you has been studied in the light of our knowledge of the early days and I am able to tell you that it belonged to a freight locomotive dating from the beginning of the twentieth century. I have not been able to recover any other parts of the engine, but this is sufficient to enable us to say that the locomotive to which it belonged was of the Mikado or 2-8-2 type, and

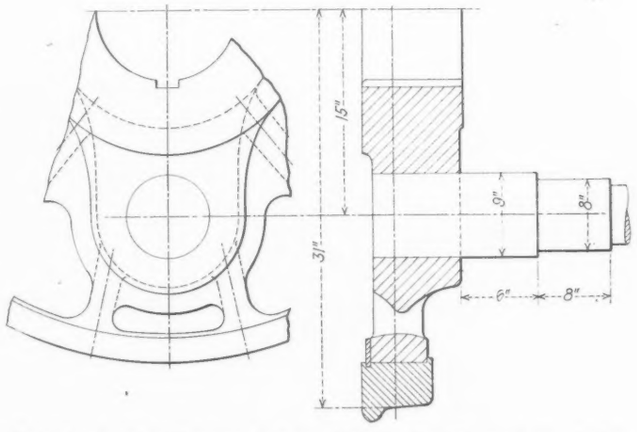


Exhibit A—The Fragment From Which the Dimensions of the Locomotive Are Determined

that the total weight of the locomotive was approximately 330,000 lb. in working order, of which about 240,000 lb. was on the driving wheels. My calculations show further that the heating surface was approximately 4,000 sq. ft.

and that the cylinders gave a maximum tractive effort of approximately 60,000 lb. The cylinder diameter was 26 or 27 in., but the exact dimensions cannot be settled without further information." "Now, gentlemen," our professor might continue, "I see some of you, and particularly you, sir, from Jefferson City, who look incredulous. Let me show you how the dimensions I have given can be elicited from the part before us:

"Our point of departure is the main rod bearing on the main pin which measures, you will observe, 8 in. by 8 in., thus having a projected bearing area of 64 sq. in. Now as good practice permits a maximum piston thrust of 1,800 lb. per square inch of projected area, this bearing would be adapted for a maximum thrust of $64 \times 1,800 = 115,000$ lb. The side rod bearing on which a pressure of 1,600 lb. per square inch is proper has $9 \times 6 = 54$ sq. in. of projected area and is thus proportioned for a thrust of $1,600 \times 54 = 86,400$ lb., which is 75 per cent of the total thrust on the pin. It is evident that this main pin was designed to transmit three-quarters of the pin thrust to the coupled axles, one-quarter of the thrust being taken up by the main axle. There must, therefore, have been three other axles coupled to the main axle. The locomotive must have been of the eight-coupled species.

"Now the maximum piston thrust which we have estimated at 115,000 lb. is the thrust of a single piston with full boiler pressure behind it. The relation between this and the rated tractive effort, that is the tractive effort delivered at the rail by two cylinders with 85 per cent of boiler pressure as mean effective pressure, is:

$$\frac{\text{Tractive Effort}}{\text{Maximum Piston Thrust}} = 1.08 \frac{\text{Stroke}}{\text{Driving Wheel Diameter}}$$

which gives 60,000 lb. for the tractive effort. This with a factor of adhesion of 4.0 gives 240,000 lb. as the weight of driving wheels. From the cylinder tractive effort to the boiler dimensions, connection is made by the Boiler Demand Factor, or B.D., which is:

$$\frac{\text{Tractive Effort} \times \text{Driving Wheel Diameter}}{\text{Heating Surface}}$$

A probable value for this factor for an eight-coupled engine of this period with 62 in. drivers would be 900,* which leads to the equation:

$$\frac{60,000 \times 62}{\text{Heating Surface}} = 900$$

This shows a heating surface of 4,010 sq. ft."

At this point the professor stops a moment partly to catch his breath, partly for rhetorical effect and partly to see how his deductions are being received. Noting for a second time a critical gleam in the eye of the Missourian, whom he had already singled out, the professor continues, "In the matter of heating surface, you will doubtless remind me that for a proper choice of the B.D. factor we must know whether the locomotive used saturated or superheated steam. I have assumed superheat and for these reasons: My examination of the crank pin shows it to be made of heat treated steel, while what we have of wheel center shows care in design. We may, therefore, conclude that the early designer was abreast of his times, and would not have been so lacking in judgment to build an eight coupled engine with 60,000 lb. tractive effort without equipping it with superheat. In the period to which our fragment evidently belongs, it was usual to make the superheating surface 23 per cent of the heating surface, which gives for our reconstruction about 920 sq. ft. of superheated surface.

"From the heating surface we are led to the total weight in working order, by knowing that a well designed superheater locomotive weighs about 80 lb. for each square foot of heating surface. On this basis we have $4,010 \times 80 = 320,800$ lb. total weight. We concluded previously that 240,000 lb. was carried on the four coupled axles so that the difference of 80,000 lb. is to be carried on a truck or trucks. Now, gentlemen," we hear the professor saying, "the adhesive weight of 240,000 lb. was carried on four axles, from which we may assume that the maximum allowable axle load was not greatly in excess of 60,000 lb. Certainly the truck load of 80,000 lb. is too great for a single axle. We, therefore, know that the engine must have had four driving and two truck axles. It is possible that this was a 4-8-0 type, but this type was unusual, particularly in the part of the country in which our fragment was unearthed; I am therefore confident that it belonged to the 2-8-2 or Mikado type. The size fixes its date as early in the twentieth century."

With his reconstruction thus completed our professor accepts with a satisfied smile the applause of his audience. Looking critically at his deductions we find them generally sound, his only unsupported assumption being that the fragment came from a correctly proportioned locomotive. Indeed, the fact that he carried his speculations no further is most creditable to his self restraint. In his place, twenty centuries away from the possibility of checking the reconstruction against the original, we doubt if we should succeed in maintaining such an admirably conservative tone. It would be all too easy to hazard a couple of plausible guesses, which would start a new series of calculations and lead to the revelation of practically everything except the engineer's first name.

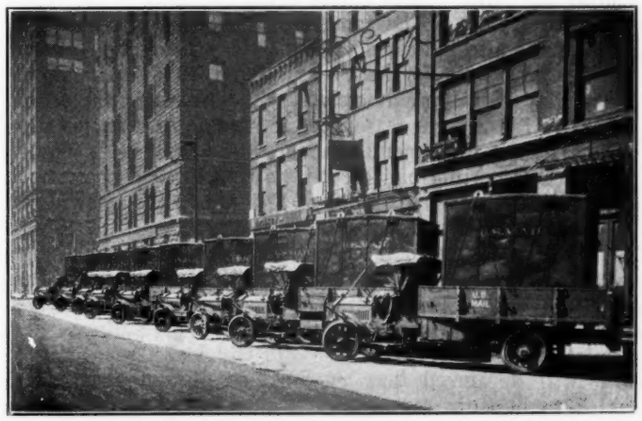
If it should happen that any of the students attempt to check up their professor by a search of the old records, it is possible that they will find that the main wheel and pin on which he has hung his parable have the same dimensions as the corresponding parts of the Pennsylvania Railroad 2-8-2 type locomotive, this company's class L1S, the principal dimensions of which are:

Cylinder diameter	27 in.
Cylinder stroke	30 in.
Boiler pressure	205 lb. per sq. in.
Driver diameter	62 in.
Tractive effort	61,500 lb.
Maximum piston thrust	117,374 lb.
Heating surface	4,018 sq. ft.
Superheating surface	1,172 sq. ft.
Grate area	70 sq. ft.

Weight in working order on driving wheels	240,200 lb.
Total locomotive	320,700 lb.

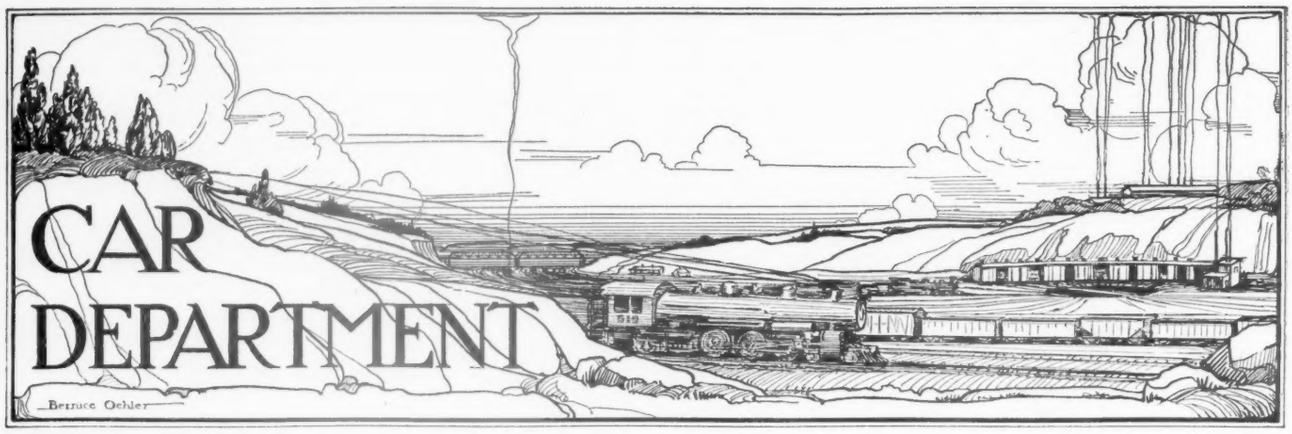
FACTORS:—

A	=	$\frac{\text{Weight on drivers}}{\text{Tractive effort}}$	= 3.82
B	=	$\frac{\text{Tractive effort}}{\text{Heating surface}}$	= 15.3
C	=	$\frac{\text{Heating surface}}{\text{Grate area}}$	= 57.5
BD	=	$\frac{\text{Tractive effort x driv. diameter}}{\text{Heating surface}}$	= 950
E	=	$\frac{\text{Total weight}}{\text{Heating surface}}$	= 78.6



A Carload of Mail Containers Ready for Delivery to the Post Office

*Apparently the professor has had access to the *Railway Mechanical Engineer* of April 1921, page 215.



Does It Pay to Repair Foreign Freight Cars?*

Some Relations Between Freight Car Repairs, Transportation Expenses and the Income Account

By N. D. Ballantine
Superintendent Transportation, Union Pacific System

MASTER Car Builders' Rule No. 1 reads as follows: "Each railroad is responsible for the condition of all cars on its line, and must give to all equal care as to inspection and repairs, regardless of responsibility for expense of repairs." This rule, however, was not followed even under Federal control. In support of the conclusion that the same condition still exists, a brief consideration of the bad order situation may be worth our while.

We can doubtless agree that mass figures, involving a large number of items, probably reflect a situation more correctly than similar data compiled by an individual carrier. Before proceeding further, however, it may be well to see if we can also agree that there has been no material change in the manner in which roads repair cars or report their bad order situation now, as compared with practices in vogue under Federal control.

Data deduced from some records kept while with the Car Service Division of the U. S. Railroad Administration covering the repairs given to freight cars during the years 1918 and 1919, indicates that with about forty-five billion freight car miles produced during the two years, there were about forty million repairs, heavy and light, given to freight cars. This means that each freight car moved an average of 811 loaded and empty miles before being switched to the repair track for repairs. The same factor obtained in each year. The figures also indicated that of the total cars bad ordered, 9.6 per cent were for heavy repairs in 1918, and 9.4 per cent in 1919, or approximately 10 per cent during the period.

Would it not seem reasonable to assume that unless there has been some fundamental change in the methods of making repairs or reporting bad orders, we could safely continue to use for the country as a whole, 811 miles as the average service which will create a bad order car?

In the table, the total freight car miles has been divided by 811 to obtain the column headed "Bad Order Cars Produced." With this exception, the figures shown are taken from statistics furnished by the Bureau of Railway Economics and Car Service Division of the A. R. A.

It will be agreed that we have no absolute basis with which to measure car repairer's efficiency, but during the period of comparison I believe it will generally be conceded that the output per car repairer increased materially.

FACTORS IN THE BAD ORDER CAR SITUATION OF CLASS I RAILWAYS OF THE UNITED STATES

Month, 1920	Home cars on home roads	Average bad order cars on hand	Bad order cars produced	Car repairers
October	731,699	177,655	2,657,471	95,068
November	749,774	181,595	2,397,046	91,188
December	790,933	189,490	2,275,218	84,123
1921				
January	1,074,661	209,667	2,118,640	70,307
February	1,396,048	234,506	1,772,067	60,319
March	1,612,185	260,230	1,923,808	54,537
April	1,689,225	296,233	1,836,170	50,051
May	1,744,907	329,850	1,969,360	52,919
June	1,764,612	351,465	1,980,122	54,410

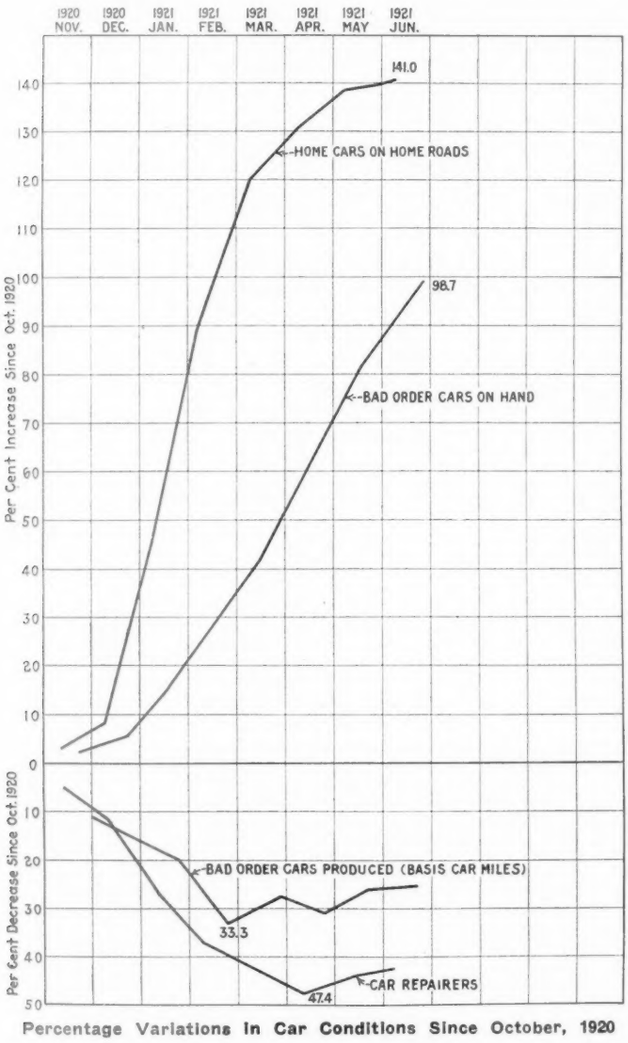
From time to time we read in the newspapers and lately even in the Railway Age reference to the abnormally poor condition of the freight equipment of the country, conclusions generally being drawn, I infer, from a comparison of tabulations made by the Car Service Division as to the bad order cars on hand. The real situation as to condition of freight equipment should not be concealed nor, on the other hand, magnified. However, I feel that the figures for bad order cars on hand, taken alone, are prone to mislead as to the real condition, for the reason that during the period under consideration, a very unusual situation developed in connection with the return of cars to their owners. Had M.C.B. Rule 1 been generally observed in spirit or letter, the effect of relocation of cars to home lines would not have been accompanied by such a substantial increase of bad orders, but surely our mechanical friends who are at all familiar with actual conditions will agree that during the period referred to, and probably up to the present time, their practice was to card a large percentage of system cars "Bad Order," while a foreign car having, as nearly as could be determined, the same defects, but safe to run, was not so carded, but sent home—there to be carded. What really happened then, is that while there was a substantial decrease in the factors producing bad orders car repairers were decreased somewhat in proportion, slightly more, but their efficiency increased, while bad orders reported mounted at an extremely rapid rate, following the trend of the rapid return of cars to owners.

The chart on the following page, which is self-explanatory,

*A paper read before the Western Railway Club, November 21, 1921.

may help to visualize the relations existing, and would seem clearly to indicate that until such time as M.C.B. Rule 1 is generally observed, in proportion as home cars on home roads increase, the bad order reports will show an increasing number of bad orders, although there may be no real difference in the actual physical condition of car conditions as a whole.

Manifestly, M.C.B. Rule 1 will not be observed until such time as allowances for the repairs to foreign cars are equal at least to a sum sufficient to compensate a road for doing such work, including supervision, shop overhead, interest, depreciation, insurance and taxes covering the facilities used in making car repairs, together with the cost for switching and the per diem equivalent while cars are out of revenue service to be repaired. Owing to the widely varying conditions and



Percentage Variations in Car Conditions Since October, 1920

ideas existing with respect to the cost of overhead and the other items above referred to and lack of sufficiently reliable data covering the matter, this phase of the subject will not be dwelt upon. These factors can only be determined through an actual and careful study of local conditions.

My object will be to point out a basis upon which a study could be made to include some important relations which exist, in order that a proper policy may be adopted, having in mind the best interests of a property as a whole, without regard to departmental lines.

Direct and Indirect Expense

Let us define direct expenses as all items affecting freight car repairs which can be, and generally are, charged directly to the particular job, and indirect expenses as all other items affecting freight car repairs which can properly be included in the overhead and other items already referred to and which cannot be directly charged.

Owing to the difficulty of determining the "indirect expense," and for want of a better basis from which to draw conclusions, I shall confine myself to some deductions or comparisons from the item, "direct expense."

The relation between the prices allowed under M.C.B. rules and the direct expense involved in doing that particular piece of work should represent the allowance for the indirect expense. For example, if labor costs 72 cents an hour and M.C.B. rules permit billing for labor at $1.20 an hour, then 66.6 per cent of the direct labor expense is to apply on the indirect expense A comparison on the above basis, covering labor and various other items which go to make up the principal material used in car repairs might be of interest and value to any road.

Per Diem

While per diem does not directly affect any operating account nor a road's operating ratio, it does affect a road's net income through the "hire of equipment" account. Therefore time is an important element in the matter of repairs to foreign cars in its effect upon that portion of the M.C.B. allowance covering the indirect expense as the following illustration will show.

Assume that an average of $15 per day direct expense could be economically applied on a foreign car, and that it had been determined through the method above outlined that 33.3 per cent of its direct expense was available to apply on the indirect expense. Then $5 would represent the indirect portion. As seven days per diem would be paid covering six working days it would be equivalent to $1.17 per day and would absorb 23 per cent of the indirect allowance. If, however, it should take two days to spend such a sum, then 46 per cent of the indirect allowance would be absorbed by the per diem paid out while undergoing repairs. Therefore, in proportion as the labor and material applied per day can be increased, the effect of per diem in absorbing the indirect allowance will diminish. With a little carelessness or delay in handling foreign cars, then the indirect portion of the allowance may be wholly absorbed in this one item.

Loss of Revenue

During periods of heavy demand for cars, the less time a car spends on the repair track the more time it is available for producing revenue, and its effect upon the net revenue can clearly be shown in the following manner:

Assume that the freight revenue per freight car mile, loaded and empty, is 20 cents, and that the average miles made per car per day is 30. Then such a road would be able to earn on the average a gross freight revenue of $6 per car per day. If its freight operating ratio was 75 per cent, then $1.50 per car per day would represent the net revenue from operation. Clearly, then, for every day a car is held out of service in bad order during periods of demand this would be a proper item to consider in the determination of what should or could be done to avoid such delay.

Switching

I believe it will readily be conceded that the present day cost of a switch engine, including rental and repairs, will vary from $10 to $14 per hour. If it is correct in principle to add a percentage to the direct expense for freight car repairs to cover the overhead and plant facilities, and I believe it to be, the same principle should apply in determining the cost of switching. Regardless of agreement with the principle suggested, take any rate you may see fit and measure it with the service actually performed to determine, if practical, what proportion of the indirect allowance switching

may absorb. For the purpose of this illustration, let us use $10 per hour as the cost of a switch engine. Assume the simplest typical case involved in removing just one bad order car from an inbound train or transfer, which we will say consists of 40 cars. On an average 20 cars will need to be handled in cutting out the bad order to be placed upon a temporary hold track, which operation would consume on an average at least five minutes. It would also easily consume an average of five minutes per car to remove a string of cars from the temporary hold track to the repair track and space them a total of at least 10 minutes to put the car on the repair track, and the same amount of time to remove it, or, say, 20 minutes as a minimum. On the basis of $10 per hour, the cost for the four switches involved in cutting out a bad order and placing it on the repair track would be $3.33, or 66.6 per cent of the $5 to apply on the case previously cited, where $15 direct expense was applied in one day. Therefore, in proportion as the amount of labor and material applied can be increased for each time a car is switched to the repair track, the effect of switching expense in absorbing the indirect allowance will diminish.

It should be clearly borne in mind that the estimates of time consumed by a switch engine in setting out a bad order car is purposely intended to conservatively cover the simplest case, and does not cover those cases where, due to accumulations of bad orders, the cars are switched to outlying tracks and later culled over from time to time, the lightest repairs, etc., being selected, the cost for which latter method of handling is of course much greater than the above estimate.

Empty Car Mileage

A conservative estimate of the average out-of-pocket cost of the movement of an empty freight car per mile on the railroads of the United States at the present time would be 5 cents, not including the per diem or mileage payments.

In proportion as the demand for box cars in good physical condition with which to load flour, sugar, grain, etc., increases, with a given number of rough freight box cars circulating upon a road, the empty mileage and switching is bound to increase. A rough freight car may be suitable for loading l.c.l. or merchandise traffic, say to a branch line point where the outbound business is grain. But if such a car is used it must be hauled away empty and a grain car sent in, causing a cross-haul and unnecessary empty mileage.

M.C.B. Rule 120 provides that a foreign car in general wornout condition shall be reported to the owner with an estimate of the cost of making repairs. The owner has but two options, viz., to authorize the repairs, or the destruction of the car wherever it may be located. Nevertheless, many roads, under special agreements between their mechanical departments, are moving such cars home for repairs. Unless such movements are authorized or concurred in by the transportation departments, decidedly uneconomical movements are likely to occur if factors other than the purely mechanical are considered. Before a proper decision can be made as to the economics of a case, the principal factor to be determined is, "Could the car, if repaired where located, be given a load in the direction it would otherwise move empty as a bad order?" If the answer is "Yes," then it is proper to double the mileage the bad order car would make to determine the total unnecessary empty mileage involved.

For example, a Pennsylvania box car at Ogden in bad order, if sent to the owner at Chicago would involve 1,500 empty car miles, and if the excess box car loading were eastbound, it would mean the necessity of moving some other box car empty westbound 1,500 miles, involving 3,000 excess empty car miles as compared with repairing the car at Ogden and loading it to Chicago. At 5 cents per car mile, this would mean an out-of-pocket expense to the carriers involved of at least $150. On the other hand, if a Southern Pacific car located at Chicago were safe to run, but otherwise would be considered a bad order, and the movement of empty box cars were westbound, it would be more economical to all concerned to send such car home and let the owners repair it, there being no excess empty car miles involved, and the owner could probably make the repairs for 20 per cent less than it would cost a foreign road to do so.

Loss and Damage

The A.R.A. Freight Claim Division has recently issued a memorandum indicating that practically 10 per cent of all freight claim payments made during the seven months ending March 31, 1921, aggregating $5,876,056, was paid on account of defective and unfit equipment; and $3,243,806, or 55 per cent, of the total payments on account of defective equipment was for grain, flour and sugar, grain alone amounting to $1,818,664, or 31 per cent.

There are, of course, many factors involved, but suffice it to say that the bad order situation appears to me to be vital, and one which can and should be improved.

When it is necessary to switch a car to a repair track and incur the transportation and per diem expense, regardless of the initials on the car, when practical the required work should be done thoroughly and expeditiously.

In other words, the rules should be made so that the signers of the agreement will observe Rule 1, and coincident therewith I feel sure there will follow reduced cost of freight car repairs and transportation expenses, as well as a reduction in the hire of equipment account.

Discussion

A number of reasons were given in the discussion why foreign freight cars are not better maintained when away from home. One reason mentioned by F. H. Hammill, assistant general manager, Chicago & North Western, was the difference in the design of equipment owned by different railroads which adds to the difficulty of making repairs to foreign cars and makes this work cost more than similar work to the home cars. Mr. Ballantine suggested that a sufficient compensation in the price rules might meet this condition.

C. B. Peck, *Railway Mechanical Engineer,* suggested that while Mr. Ballantine's deductions from his table were no doubt correct, the important point to be determined was whether the present bad order reports or the reports prior to the heavy coal movement were to be considered as more nearly reflecting the true conditions. He presented an analysis showing the gradual increase of bad-order cars requiring heavy repairs from 53 per cent of a total of 175,000 bad-order cars in August, 1918, to 67 per cent of 174,000 bad-order cars on November 1, 1920, just before the beginning of the heavy home movement. These figures indicate a material decrease in the serviceability of equipment during the period shown and disclose an accumulation of repairs not shown by the figures for all bad orders.

J. J. Tatum, superintendent car department, Baltimore & Ohio, sketched the conditions obtaining during the railroad administration which made it necessary to give attention primarily to running gear, draft gear and brakes, leaving the superstructure to receive such repairs as circumstances would permit. He outlined a plan for regional shops to take care of cars of groups of railroads, to be located at the principal gateways where cars are interchanged in large numbers. In reply to a question Mr. Tatum stated that the prices for work done in the regional shops would have to be high enough to pay a profit on the capital required for the establishment of such shops if they are to be established.

Mr. Ballantine showed the benefit of keeping up car repairs by the experiences of the Union Pacific which during the six or eight months covered by the table in his paper put about 60 per cent of its box cars through the shop for heavy repairs. Following the repairs to these cars the mileage between repairs increased to 2,538 as compared with the average of 811 for the United States.

Reclaiming Sheets of Outside Metal Car Roofs

Important Savings in Car Repair Costs Result from Moderate Expenditures for Facilities

AS ONE of the results of pooling equipment and deferring maintenance during the period of federal control, owner lines are now having returned to them a great number of box cars requiring extensive repairs to roofs. At the present time one large eastern line has from 10,000

Car With Roof of Reclaimed Sheets

to 15,000 box cars equipped with various makes of metal roofs which are in need of roof repairs. Providing new metal for the roofs of these 10,000 to 15,000 cars would entail an expenditure of from $500,000 to $750,000. To avoid this heavy expense, the road has established plants for reclaiming used roof sheets at 31 points on its system where cars are repaired.

In the great majority of instances, the wear in the original metal sheets was due to poor material supplied during the war period, resulting in leaks occurring at the lower edge of the sheets at the eaves of the car where the sheets overlap the flashing. The plan for reclaiming the sheets involves their removal from the car, cutting off the worn end, reforming and painting.

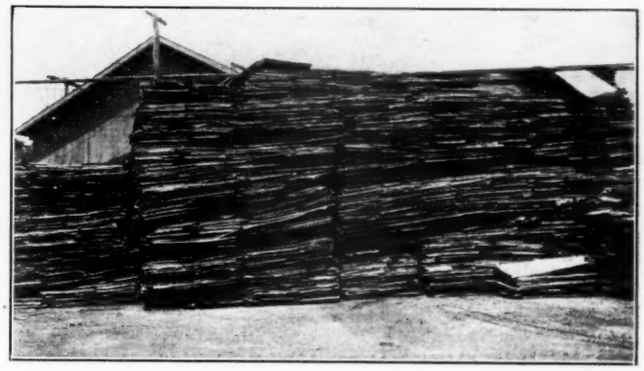
The roofing sheets, now being reclaimed, originally were

Sheets Before and After Reclaiming

of two lengths, 4 ft. 6⅝ in. and 4 ft. 8⅞ in. Both length sheets were used with 4¼ in. flashing. As reclaimed the 4 ft. 6⅝ in. sheets are cut back to a length of 4 ft. 3 in. and used with 7 in. flashing if the wear in the original permits. Where the wear is greater the sheets are cut back to a length of 4 ft. 0 in. and used with 10 in. flashing. Sheets originally 4 ft. 8⅞ in. long when reclaimed are cut back to 4 ft. 5½ in. for use with 7 in. flashing and to 4 ft. 2½ in. when 10 in. flashing is used.

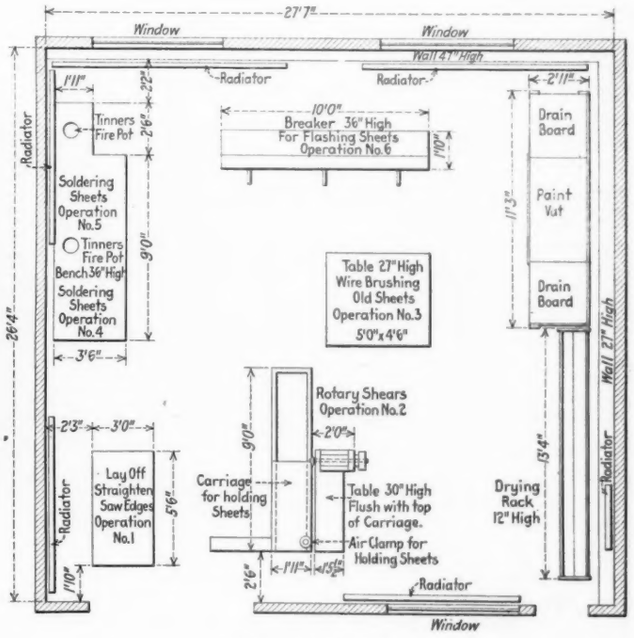
Roof sheets which are not suitable for use with either the 7 in. flashing or 10 in. flashing are squared and split in the center of the width after all defective metal has been cut off the ends, and are then formed into 7 in. flashing. The 10 in. wide flashing is made from new galvanized iron.

The drawing showing the arrangement of the facilities in



Defective Roof Sheets Formerly Used for Building Purposes or Sold for Scrap

the car roof reclaiming shop illustrates the simple and inexpensive layout and equipment required. The building is of frame construction, 26 ft. 4 in. wide and 27 ft. 7 in. long. The equipment is standard and includes facilities for straightening the sheets, rotary shears for cutting the sheets



Layout of Shop

and the flashing, a table used in connection with the shears for holding the sheets while being cut, a break machine for reforming the ends of the roof sheets and the flashing, a

table and wire brushes for cleaning old sheets, tinning and soldering outfits and painting vats and drying racks.

The reclaiming involves six operations; straightening, clipping, cleaning, soldering, reforming and painting. The painting is done by the bath method, and a second coat of paint is applied to the top of the sheets and the flashing after the roof has been rebuilt and applied.

In applying the reclaimed material to the car roofs standard practice, as it obtains with new material, is followed closely. The flashing is nailed to the side facia and a hold-on-clip or cleat is used to hold the flashing. This is nailed to the roof carlines or to the sheathing. Where there is no carline for the nails they are driven through the sheathing and clinched. The flashing has an interlocking seam at each end to prevent leaks.

One of the photographs shows a pile of defective roof sheets. Before the plan for reclamation was perfected these sheets were used for building purposes, covering bridge ties and so on. Many of them were sold as scrap or disposed of in fills along the right-of-way. Another photograph shows piles of roof sheets before and after reclaiming, while a third photograph shows a car roofed with the reclaimed material.

With the facilities described a daily output of sheets and flashing sufficient to provide roofing for five cars is secured at each of the plants. This is done with an expenditure totaling less than $28 per day per plant or, in other words, at a cost slightly in excess of $5 per roof.

Support for Passenger Cars Undergoing Repairs

By Norman McCleod

WHAT might be termed a refinement in the design of a supporting portable trestle for passenger cars while they are undergoing repairs is shown in the accompanying illustration. This device has a number of advantages over the old wooden trestle, the principal one of which is that, being supported on wheels, it can be moved or shifted at will with a minimum amount of labor.

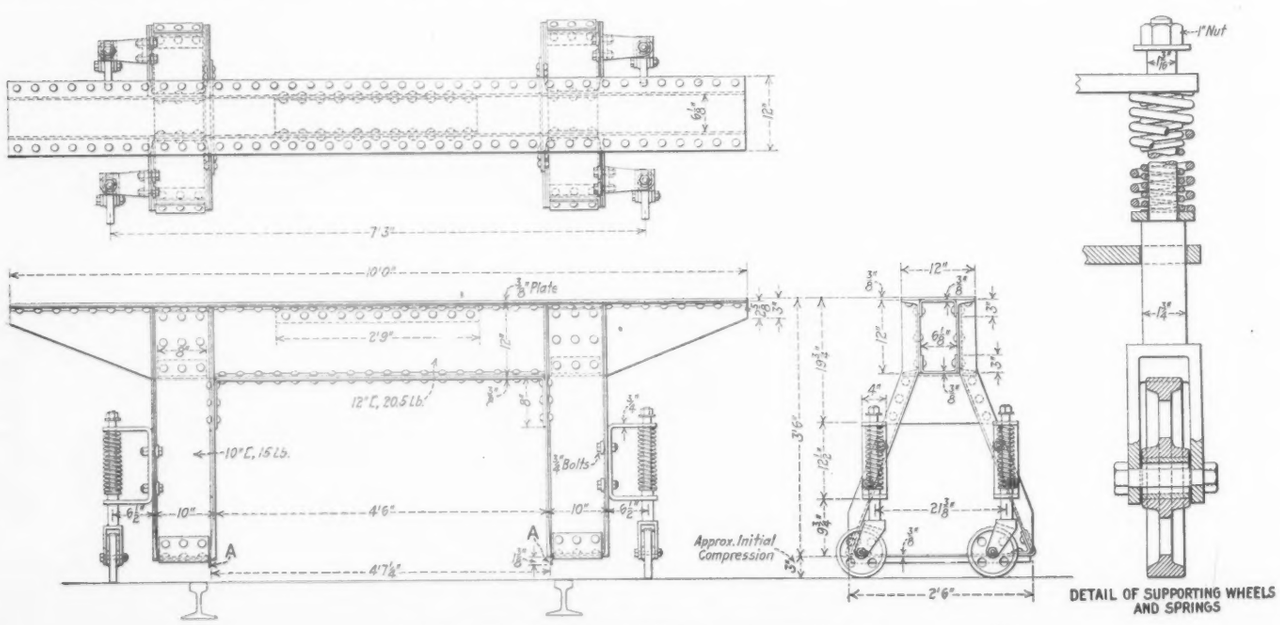
The trestle is built of 10 in., 15 lb., and 12 in., 20½ lb. channels and ⅜ in. steel plate. It is supported on four 8 in. diameter wheels, equipped with roller bearings. The weight of the trestle is more than balanced by four sets of car springs, capable of taking care of about 1,260 lb. each, approximately three inches compression being required to bring the trestle down on the rails.

Provision is made for keeping the trestle in alinement with the track by two projecting flanges, as shown at A, which assume a position adjacent to and just inside the heads of the rails when the weight of the car is placed on the trestle. The details of the wheel, bearing, springs and spindle are shown on a larger scale at the right hand side of the illustration.

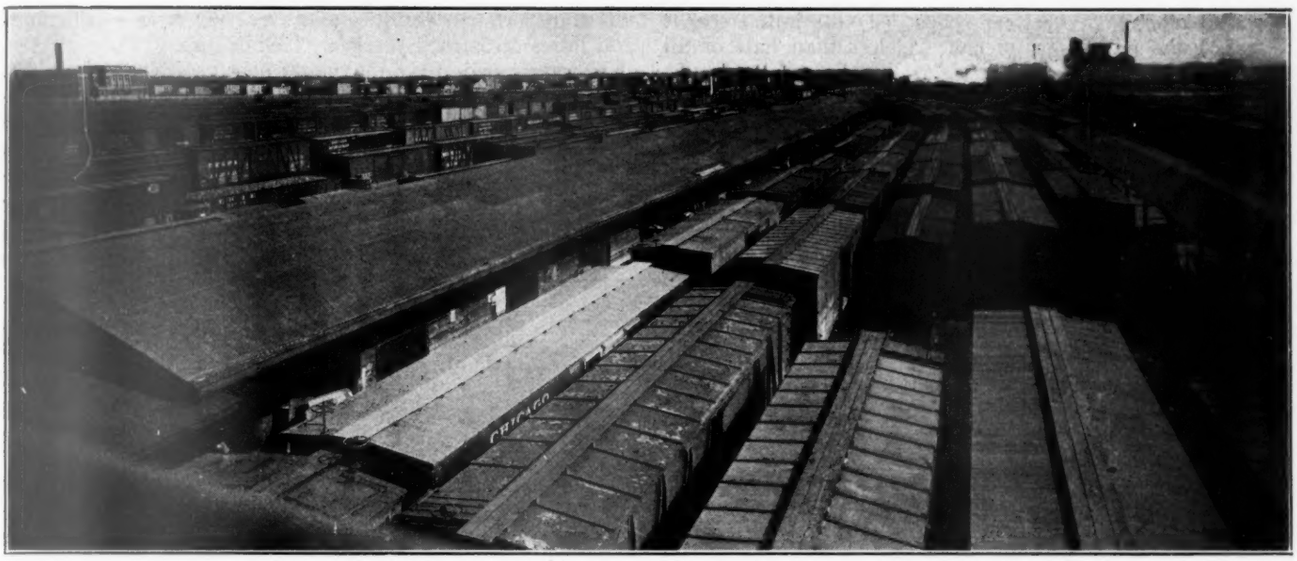
The drawings are self-explanatory and the feasibility of the device is apparent. A number of these trestles are in service at the various passenger car repair shops of one of our large railroads and they have proved to be much more durable and satisfactory than any other design used in the past.

Record Ore Loading. What is claimed to be a world's record for loading a cargo of ore was established recently according to the dock office of the Duluth & Iron Range, when the steamer *D. G. Kerr* took on 12,506 tons of iron ore, in sixteen minutes. This office reports that the steamer tied up at the dock at 4:44 p. m., loading and raising the last chute by 5:00 p. m.

In America for many years the passenger cars have been made of steel; ours are for the most part still of wood—no doubt that they may burn faster. In America they have automatic couplers, which prevent accidents and save time; in France there are still unhappy human beings who have to lock the cars together one after the other by hand. In America there is not a coach which does not have its two wash rooms, one for women, the other for men; in France a third of the cars have no wash rooms and in those that have them they are kept by ineradicable tradition filthy. In America, in the Pullman cars, which correspond to our first class, each passenger has at his shoulder a small electric light which enables him to read, and a tiny table on which he can work; in France, even in the de luxe cars, it is impossible most of the time to see clearly after dark. In America each coach is furnished with a reservoir of cold water and with paper cups from which to drink; in France, in point of water, there is only that which drops on your head when you go to the wash room. —*Stephane Lauzanne in Le Matin (Paris).*



Convenient Portable Trestle for Passenger Cars



Galewood Yard, Chicago, Milwaukee & St. Paul

The Use of Wood in Freight Car Construction

Is the General Use of All-Steel Construction Justified? The Advantages of Composite Design

By H. S. Sackett
Assistant Purchasing Agent, Chicago, Milwaukee & St. Paul

THE most important feature of transportation in relation to commerce is naturally the freight traffic; thus, in the evolution of steam locomotion the problem always has been the construction of freight cars to meet the requirements of economic operation. From the first type of horse drawn freight car operated on the Baltimore & Ohio, antedating the steam locomotive and moved over timber rails, to the present quasi-standard 100,000-lb. capacity box car designed during the war, wood has maintained its important place because of its inherent suitability for the purpose which has been indisputably established not alone by its service record during the nearly 100 years of railroad history, but ever since merchandise was first transported on sleds; even before the invention of wheels.

A growth from 35 miles of railroad in 1835 to a total of 370,000 miles in 1918, and the development from locomotives of 15½ tons previous to 1850 to the electric "King of the Rails" of 1920 weighing 550,000 lb., and the Santa Fe type weighing over 400,000 lb., are graphic illustrations of progress fully comparable with the unprecedented commercial advance of the United States during the same period.

Developments in Car Construction

Car construction cannot boast of such intense application. Looking back through this phase of railroad history one can hardly escape the impression, that generally speaking, freight cars "just grow'd" like Topsy, at least up to about 20 years ago when the pendulum started on the swing toward the present extreme of super-heavy construction.

In 1867 the Master Car Builders' Association accepted 20 tons as the maximum capacity of box cars. Today the indications are that cars of 100,000 lb. capacity will soon be the standard. These changes naturally made obsolete the older types of equipment as the lighter construction became entirely inadequate to meet the requirements of modern traffic. Thus was developed the quasi-standard type of steel underframe construction as typified by the double-sheathed box car, developed during the past three years.

At the present time, to go beyond this to the all-steel closed-top freight car is hardly good, conservative engineering practice. All-steel cars can, at best, be considered but experimental, as only about ten years of worth-while experience has been had with such equipment and during this period such authentic evidence as is available points to excessive maintenance as compared with composite cars.

Up to this time, furthermore, the steel car has been developed mainly by the railroads which serve the steel districts, and this fact is undoubtedly responsible for their ultra-development by such roads. Likewise, railroads traversing forested regions have held more closely to the wooden or composite cars. The desire to aid in marketing a local product, therefore, has doubtless been a strong factor in the development of the all-steel car.

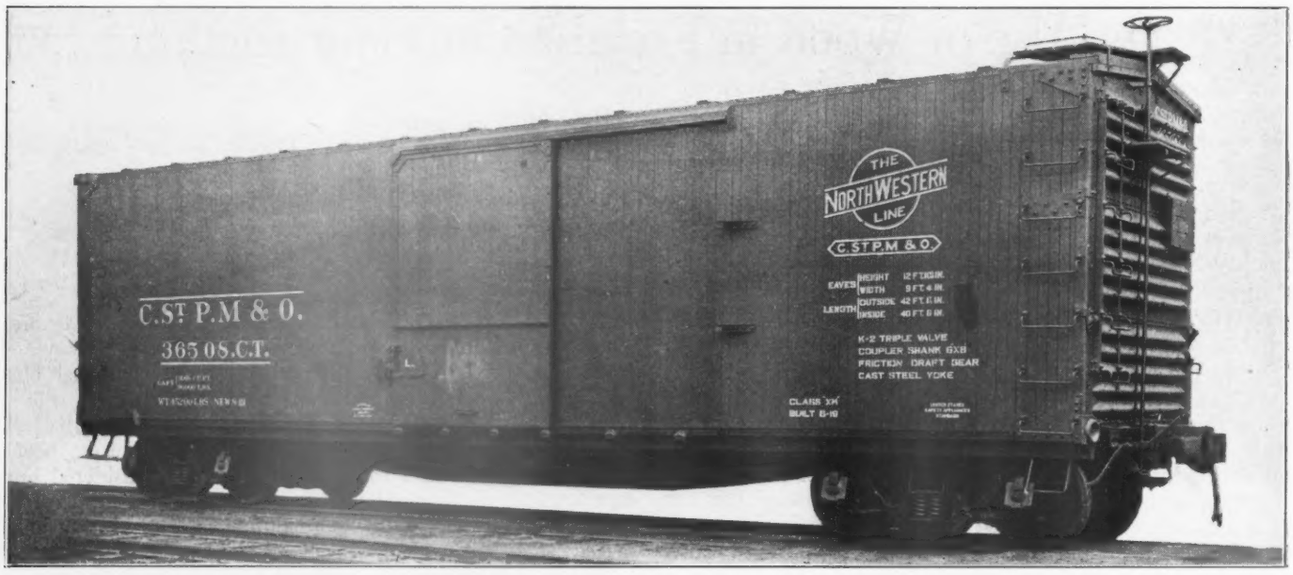
In this connection too it is of interest to note the recent announcement of the Pullman Company of a return to the composite sleeping car, one of steel understructure with steel skeleton superstructure insulated and finished with wood. This combination makes a safe, strong and comfortable car and one which is certainly superior in all respects to the all-steel type.

In 1918, Z. B. Wilson, of the Southern Railroad, in the Railway Review stated, "Nothing has occurred in the past decade that would justify spending $2,500 for an all-steel box car, while we can build a composite box car with a substantial steel underframe, with superstructure and ends reinforced with steel for $1,250. The writer desires to say * *, that he is very much in favor of composition cars for the following reasons: (1) A greater proportion may be re-

paired at other than steel car shops; (2) the initial cost is less; (3) the cost of maintenance is less than half of all steel; (4) the sides do not bulge as those of all steel; (5) composite cars can be repaired in half of the time required for the all-steel, thereby materially increasing car efficiency."

However, this controversy is not new. In 1870 the first earnest discussion of the steel car is recorded in the proceedings of the Master Car Builders' Association for that year. About thirty years later we find the fruition of these debates and early studies in the steel center sill, to be followed by the all steel underframe, both of which are justified by experience, but like many reforms that are aimed to achieve perfection over night there seems to be no happy medium and we are now presented with *all steel everything*. There is one consolation in this all-steel craze, that our inbred respect for cattle and hogs, which evidently outweighs consideration for mere human comfort, will prevent the all-steel stock car.

The demands made upon freight carrying facilities have entailed changes in construction to meet new requirements. Among these factors is the high speed with which trains of great tonnage are today moved across the continent. Tractive effort has increased 3,000 per cent and with the increased cost and scarcity of labor has come fly-switching and the hump track. It would be unreasonable to expect the all-wood cars of 20 to 30 tons capacity, weighing between 22,000 lb. and 27,000 lb. and in their prime during the last decade of the nineteenth century, to meet these changed conditions. Efficiency dictates scrapping such equipment and its replacement with modern construction designed to withstand the wear of present traffic. Maintaining obsolete rolling stock is wasteful, and when certain roads spend roughly as high as 35 per cent of the total value of their rolling stock for its maintenance and repair in one year, it is time to establish with positive clarity just how much may be expended for maintenance with safety to financial soundness.



Railroad Administration Double-Sheathed 40-Ton Box Car

Relative Advantages of the Double and Single Sheathed Box Car

So far, all-steel equipment has not been proved to be the most economical. No attempt is made to prophesy future developments, but with a design adopted which meets all present and future requirements within the range of vision, sound conservation compels the building of the largest number of freight cars for the least money in order to rehabilitate transportation facilities and avoid the serious difficulties and losses occasioned yearly by lack of cars.

However, aside from the matter of expediency and present financial considerations the steel underframe, wood superstructure double-sheathed car (in some cases with metal carlines and steel ends for closed-top cars) presents physical and economic advantages, which quite distinctly identify it as the most suitable for modern conditions. These advantages may be summarized as follows:

(1) It is sufficiently rigid to withstand modern mechanical shock.

(2) It is adaptable to special conditions of lading, climate and traffic, varying with the respective territory involved, without sacrificing the standard interchangeable features of the steel substructure, trucks, draft rigging and appliances.

(3) It may be fully assembled at railroad shops, from materials (such as the lumber for superstructure) often locally available.

(4) Trained labor is more available and less costly, and can be more evenly distributed than were the construction of all steel cars concentrated in the present manufacturing centers, which alone can most economically produce the all steel car.

(5) Repairs can be made more rapidly, at less cost and at any repair yard.

(6) It provides greater protection to a majority of the various classes of lading.

(7) It is more readily suited to interchanges as it meets most effectively the requirements of climatic extremes encountered within the four boundaries of the continent.

(8) The initial cost is less. Although the reproduction value (M. C. B. Rules, 1920) is approximately nine per cent less than that of the all steel car the difference in first cost invested at six per cent compound interest for 20 years, still gives the composite car an advantage of five per cent after deducting such loss, providing maintenance of the all steel car is not greater than that of the steel underframe and wood superstructure car.

(9) The depreciation (M. C. B. Rules, 1920) is the same as for the all steel car, namely three per cent.

(10) Shippers prefer wooden superstructure as packing of lading is more convenient and less costly, because precaution need not be taken against rusted side sheets, bulging ends, condensation from roofs, or leaks of bulk lading occasioned by holes in corroded plates.

(11) It is lighter by upwards of 1,000 lb. and therefore costs less to haul.

The single-sheathed, steel superstructure outside frame car must likewise suffer by comparison with the double-sheathed car. Its chief weaknesses are unsightliness after short usage, due to the unavoidable perforating with nail holes of the single thickness of longitudinal siding, as well as the consequent exposure of lading. Where such cars are

used for valuable or semi-perishable freight, extra packing is required, and in some instances cars must be sheathed with tarred felt or waterproof paper by shippers; hence, the general unpopularity of this type of car. For such ladings as bricks, paving blocks, castings, etc., it will do unless because of poor loading the heavier pieces go through the side, or break up the siding. In addition, the first cost is greater, and the saving in volume of lumber used is offset by the higher cost of the grade and dimension required.

An average single sheathed car would require about 1,500 board feet of 1¾-in. (rough 2-in.) dressed select, B and better, Southern pine sheathing; the double sheathed car requires about 1,700 board feet, No. 1 common, 13/16-in. lining and 13/16-in. B and better siding. The difference in quoted prices (September 1920) equals a saving of $22.50 a car, which at 6 per cent compound interest during an average life of 20 years would represent $72.15 per car. If applied to 100,000 box cars of the type recently ordered, this would amount to about $7,215,000, enough to add over 2,000 double sheathed cars to the present equipment.

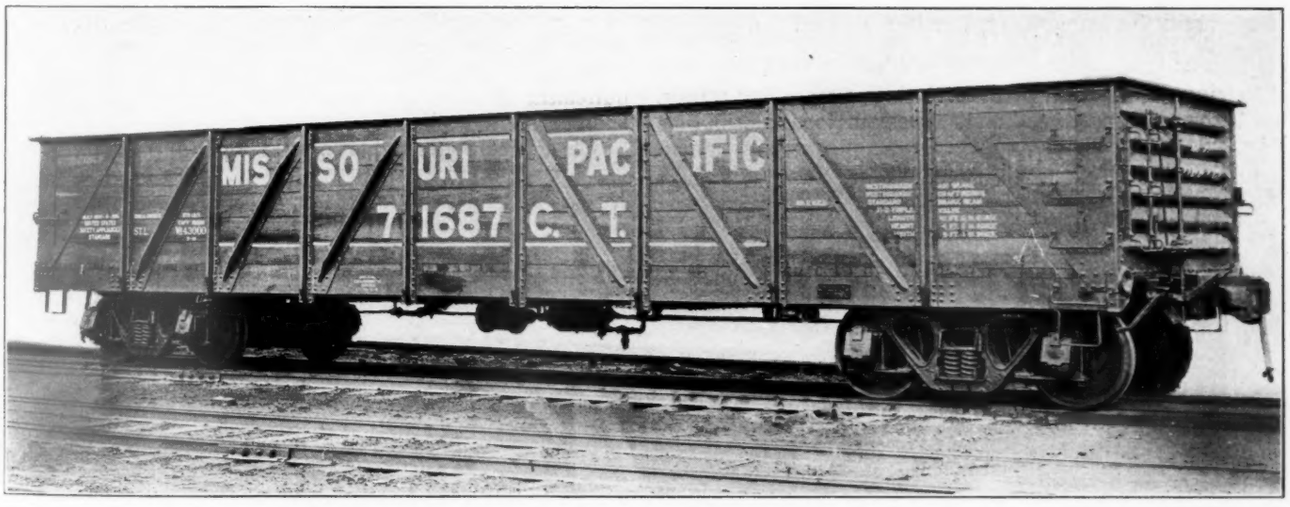
Whether the steel frame superstructure adds sufficient strength to the car, or materially increases its durability is largely guess work—a prophecy of future occurrences which the future alone can answer. At present it has not emerged from the experimental stage. Therefore, the problem is again one of comparative initial cost, and the known service of the wood superstructure against the problematical performance of the steel frame.

Modern Single-Sheathed, Steel Frame and All-Steel Box Cars

The Composite Gondola Car

Our discussion thus leads us to other types of cars, particularly, gondola, flat, stock and refrigerator cars. The latter are by their nature excluded from the possibility of all-steel construction. Gondola, coal and ore cars present different problems, but there is no question that the all-steel gondola still requires considerable development before it can be considered as a successful type. Flat cars are on the wane. Other types, such as tank cars and logging cars, are largely of private ownership and represent a comparatively small percentage of the total freight equipment, and do not materially affect the general question of efficiency in car construction.

Longer experience with all-steel gondola cars, particularly where used in bituminous coal service, indicates that depreciation is greater, maintenance more costly, and that they are consequently less economical than the composite car. In an article already referred to, Z. B. Wilson states that "the Southern Railway is operating a large number of both types (composite and all-steel coal cars) which were built in 1904 and 1905. These cars have been used almost exclusively in transporting coal. Both types are double hopper, and 100,000 lb. capacity. The average cost of repairs to 20 all-steel



Composite Gondola Car

cars was about $666.31 while the average cost on the composite cars was $240.97."

The Railway Mechanical Engineer of May, 1917, quotes the conclusions of William Queenan, assistant superintendent of shops, Chicago, Burlington & Quincy, as follows: "The composite type of car costs less to maintain than the steel gondola. The sides of composite cars do not bulge as do those of the steel car. Records show that while the composite car costs more to repaint than the steel car, it does not require painting as frequently. A large portion of the repairs to composite cars can be taken care of at other than steel car shops. Certain properties of coal cause corrosion to steel but do not affect wood."

In discussing freight car maintenance, L. K. Sillcox, then mechanical engineer of the Illinois Central, in the Railway Mechanical Engineer, October, 1917, stated: "It is simply a question of time until the greater part of a steel car must be replaced; renewals can only be economically and quickly carried out on a large scale for each car for the reason that corrosion is more or less uniform throughout each section of the structure and one part cannot be disturbed without equally effecting the adjacent one. As steel cars advance towards the time of their periodical overhauling many fail in service due to deterioration . . . ."

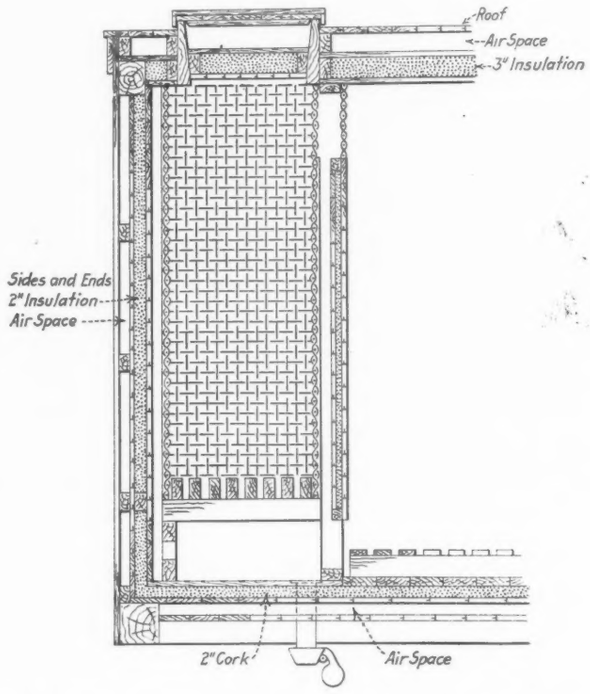
Every road having steel equipment has had to deal with these conditions during the past decade. Even the most enthusiastic steel car men are now contemplating heavier construction and employing specially treated metal to counteract corrosion. The question again forces itself to our attention whether following this costly mirage much further is good practice when composite cars have proved their worth.

Stock Cars

There can be no question that the composite stock car is both the most economical and most suitable. The wood superstructure presents sufficient protection to the lading and also a degree of comfort for the animals. There is the added advantage that all the wood in the superstructure may be thoroughly treated to make it both rot and vermin proof, and this feature permits the selection of lower grades of lumber which naturally adds considerably to the initial difference in cost between the composite type and an all steel car.

The Refrigerator Car

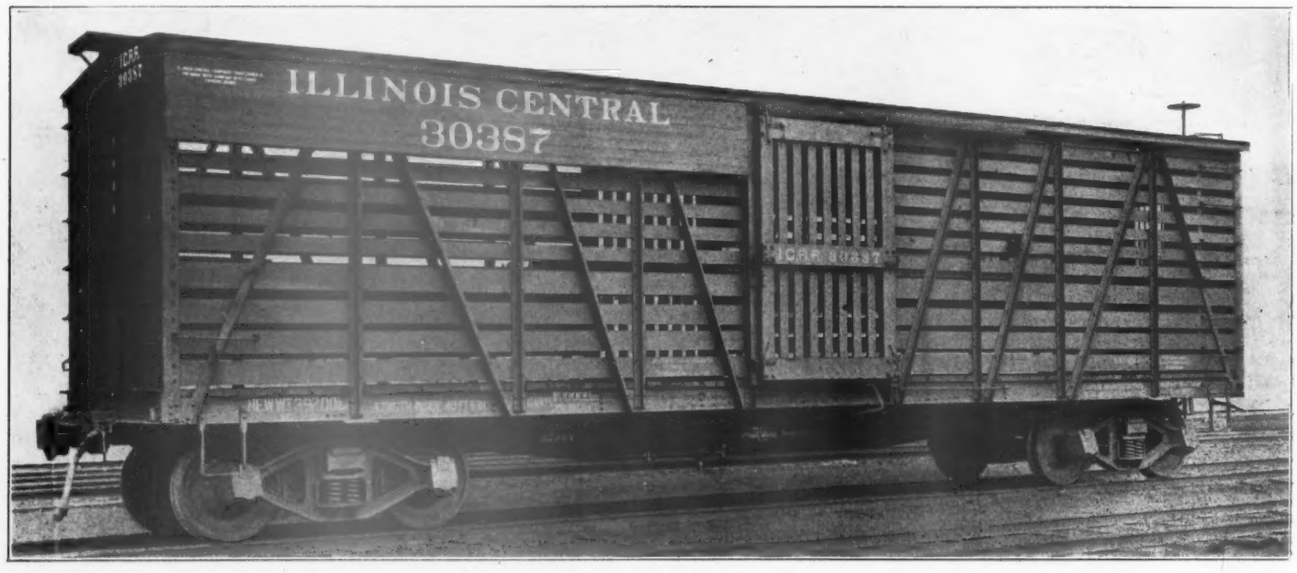
Refrigeration of food products, both in storage and transit, has become the most important element in food distribution. Properly developed and applied, it unquestionably lessens the average cost of food products and provides a normal flow of supplies to the nonproducing urban population, from the reserves accumulated from the surplus of seasonal production. Transporting perishable commodities in perfect condition would contribute greatly in cheapening the most necessary food products. Every dozen of eggs and each pound of meat, butter, fruit or vegetables spoiled in transit naturally



Longitudinal Section of Department of Agriculture Design of Refrigerator Car Insulation

increases the cost in proportion to the decrease in supply, as such loss must be equalized by higher prices for what is left in a salable condition. Therefore, the construction of a refrigerator car is perhaps of greater importance than any other type of car. As insulation is the most important requirement of a refrigerator car it is obvious that the wood body cannot be replaced.

The United States Department of Agriculture has done ad-



Modern Type of Stock Car Construction

SUGGESTIONS FOR LUMBER GRADES AND DIMENSIONS FOR NEW CARS AND REPAIR WORK

NEW CARS

	Siding		Roofing		Lining		Decking		Framing	
	Grade	Size, inches	Grade	Size, inches	Grade	Size, inches	Grade	Size, inches	Grade	Size
Box { Double sheathed.	B and Better	1 by 4 or 6	B and Better (outside).	1 by 4 or 6	No. 1 Common	1 by 4 or 6	No. 1 Common, sq. edge.	2 or 2½ by 6 or 8	No. 1 Common, sq. edge.	As specified.
			No. 1 Common (inside).							
Single sheathed	B and Better or Select, sap stain, no defect.	1 by 4 or 6	B and Better (outside).	1 by 4 or 6			No. 1 Common, sq. edge.	2 or 2½ by 6 or 8	No. 1 Common, sq. edge.	As specified.
			No. 1 Common (inside)							
Refrigerator	B and Better	1 by 4 or 6	B and Better (outside).	1 by 4 or 6	B and Better	1 by 4 or 6	No. 1 Common, sq. edge.	2 or 2½ by 6 or 8	No. 1 Common, sq. edge.	As specified.
			No. 1 Common (inside).	1 by 4 or 6			No. 1 Common, for sub-floor.	1 by 4 or 6	No. 1 Common, sq. edge.	As specified.
							All heart or No. 1 Common, treated.	2 or 2½ by 6 or 8		
Stock	B and Better	1 by 4 or 6	B and Better (outside).	1 by 4 or 6						
			No. 1 Common (inside).	1 by 4 or 6						
Gondola	Sq. edge and sound.	50 per cent full lengths 50 per cent spliced					Sq. edge and sound.	2 or 2½ by 6 or 8	No. 1 Common, sq. edge.	As specified.

REPAIR WORK

{ Double sheathed.	No. 1 Common	1 by 4 or 6	B and Better (outside).	1 by 4 or 6	No. 2 Common, sound knotted	1 by 4 or 6	No. 1 Common.	2 or 2½ by 6 or 8	No. 1 Common.	As specified.
			No. 2 Common (inside).							
{ Single sheathed.	No. 1 Common, sap stain, no defect.	2 or 2½ by 6 or 8	B and Better (outside).	2 or 2½ by 6 or 8	No. 2 Common, sound knotted	1 by 4 or 6	No. 1 Common.	2 or 2½ by 6 or 8	No. 1 Common.	As specified.
			No. 1 Common (inside)							
Refrigerator	No. 1 Common	1 by 4 or 6	B and Better (outside).	1 by 4 or 6	No. 2 Common, sound knotted	1 by 4 or 6	No. 1 Common.	2 or 2½ by 6 or 8	No. 1 Common.	As specified.
			No. 2 Common (inside)							
Stock	No. 1 Common	1 by 4 or 6	B and Better (outside).	1 by 4 or 6			All heart or No. 1 Common, treated.	2 or 2½ by 6 or 8	No. 1 Common.	As specified.
			No. 2 Common (inside)							
Gondola	Sq. edge and sound.	50 per cent full lengths 50 per cent spliced					Sq. edge and sound.	2 or 2½ by 6 or 8	No. 1 Common.	As specified.

mirable work in its investigations into the subject, covering a period of over 15 years. Its efforts have finally resulted in a so-called standard refrigerator car, as represented by specifications formulated by the recent Railroad Administration. The conclusions arrived at by these exhaustive studies and the desirable features of an efficient refrigerator car were referred to in detail by Dr. M. E. Pennington, connected with the Food Research Laboratory, Bureau of Chemistry, United States Department of Agriculture, in a brochure in which are compiled a number of papers dealing with this subject.

The 4,000 new refrigerator cars recently built and placed in service by the Union Pacific, described in the *Railway Age,* issue of December 31, 1920, follow quite generally the details outlined by Dr. Pennington. In studying the details of construction it is interesting to note that the standard recommended by Dr. Pennington represents, excepting for a few innovations or improvements, practically the all-wood refrigerator car superimposed on the standard steel underframe. Thus we have complete co-ordination of wood and steel, achieving the maximum in efficiency and economy, under present conditions. This thought may well be applied to other equipment, and although there is no parallel in service conditions, there is a distinct analogy in construction costs and maintenance.

Passenger Cars

Passenger equipment if discussed in proper detail is worthy of special treatment, and is largely a question of combining safety with comfort. Careful analytical review of the entire problem indicates that the most economical passenger car for use under present conditions is one of strong steel underframe with steel skeleton superstructure, insulated and finished with wood. It is believed that such construction will give the maximum safety in the present heavy trains as well as a high degree of personal comfort to the passengers.

Greater Economy in Use of Wood

"Familiarity breeds contempt," is an oft repeated truism and possibly this explains the lack of more active interest on the part of car builders in the matter of using wood more economically and securing from it longer service in car construction. Ever since the first freight car—a hundred years ago—wood has been an inseparable and indispensable part of car construction, and because it was plentiful in the past and the best grades readily and cheaply available as was labor for repairs, little or no care has been used to protect it against the natural conditions of deterioration. All failures to this day are classed as mechanical where fully half of the light repairs could be avoided or retarded by employment of practical remedial measures.

On the basis of consumption previous to the war one and one-quarter billion board feet in round numbers were used for car construction annually, or about 3 per cent of the total annual production. This represents an average value of nearly $45,000,000 at normal prices. A saving of about 25 per cent through increased service and decreased repairs would be a goodly item in addition to being real timber conservation.

Thus, in addition to the suggestion that elimination of wood in car construction is neither desirable nor practical, it may be said that lumber may be used more economically by paying closer attention to selection of grades and dimensions which fully answer the purpose but are cheaper, and protection of the lumber against such agencies as decay, insects, checking while in storage, etc. Timber conservation is vital to the nation, and most especially to the railroads, who, because of their prominent position, are obligated to lead in economic movements which are so potent in their beneficial influence. The basic principle of economic utilization—or popularly interpreted, timber conservation—underlies these

suggestions of changes in specifications for car lumber which, being sound, bring with them profit in the form of equivalent service at a saving in cost of material and maintenance.

Standardization has proceeded to where there is practically a standard covering grades and dimensions for the various parts of cars, such as siding, lining, roofing, decking, framing, etc. These standards, however, have not taken full cognizance of the frequent difficulties manufacturers encounter in endeavoring to conform their practices accordingly, or their utter inability to do so. The manufacturer of lumber is limited entirely by the manner in which nature provides the raw material, or rather, how the trees grow. Lumber cannot be cast in a mold, nor can it be forged to a drawing. Yellow pine, however, is produced in sufficient variety of grades and sizes to provide perfectly good car lumber quite plentifully if reasonable flexibility is allowed with regard to dimensions.

A large yellow pine mill questioned on the matter replied, "On account of the great number of patterns required by car builders, this mill has never attempted to supply any of this material, as we have found that it required too much special work and too much cutting loss." Loss is waste of material and money, because it must be paid for; its elimination therefore, means economy and conservation.

One of the fundamentals of standardization is to adapt available supplies to the required conditions, thus widening the market of supply by standardizing manufacture and developing economics that effect a reduction in production costs, resulting in stimulating competition and lower prices.

Another manufacturer suggested, "The greatest possible service that could be rendered the car builders and lumber manufacturers would be to adopt a single pattern that would serve for car siding, car lining and car roofing, and then make this pattern in standard lengths; that is to say, all lengths, using what would cut up to best advantage for roofing and siding, and the lengths that would not cut up, on the inside of the car as lining."

Where would the cost of lumber for common building purposes be, and how much greater would be our loss in timber devastation and waste if the present standards had disregarded the availability of the grades and dimensions specified? In drawing specifications for building lumber the dominating factor is to produce the greatest volume of usable stuff at the lowest cost and with the least waste. Reforms are still possible in that field and improvements are frequently accepted.

Specifications for car lumber have changed slightly during the last 50 years, but if the progress were more in line with the conditions manufacturers must contend with in order to supply the lumber to meet some of the most stringent requirements, freight cars might be a little cheaper and at least a greater volume of suitable material would be more generally available. Some builders are more concerned with appearances than with the service to be rendered. A knot in a piece of siding can cause as much comment from a railroad president as a buckled-up steel car.

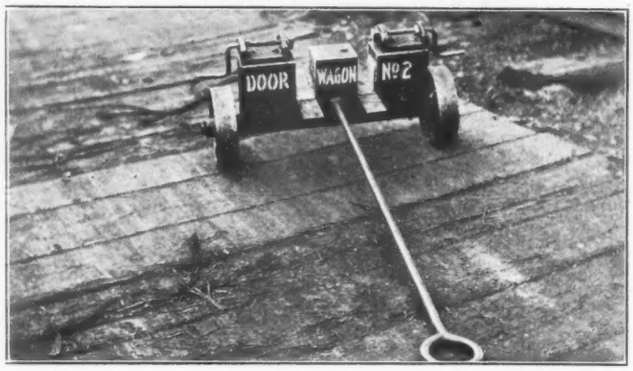
On the other hand, it is equally as important that the railroad engineers be allowed the opportunity of saying what grade and quality of material will be needed to meet their requirements. If the producers and consumers of wood used by the railroads in car construction, therefore, could thus get together on common ground, it is believed standard grades could be developed which would represent a big step of progress toward both conservation and utility—meeting the contingencies of the lumber manufacturer on the one hand and the exacting needs of the railroad engineer, on the other.

The Chicago & North Western will charge the dependents of employees half the regular suburban fare, the new ruling becoming effective January 1. Dependents of employees heretofore have been given passes.

Truck for Transporting Car Doors

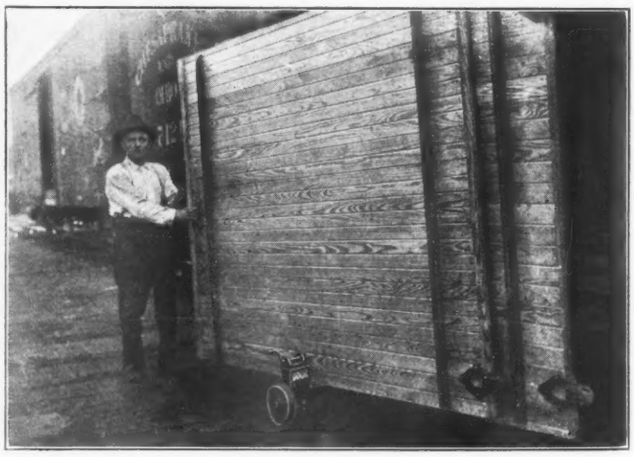
By E. A. Murray
Shop Superintendent, Chesapeake and Ohio, Huntington, W. Va.

Doors for box cars are of no great weight, but their size and shape is such that they are awkward to handle and to transport from the shop to the repair tracks. If they are carried in a horizontal position, considerable clear space is required and obstructions may be encountered that will delay their movement or interfere with carrying on other work. In addition the labor of handling is a considerable item of expense.



Truck Alone, Showing Clamps and Handle

The small truck or wagon shown in the accompanying illustrations has been used for some time and found to be both handy and economical. The truck is light and by its use one man can easily transport two doors at once. The doors are placed on the truck in a balanced vertical position and securely held by clamping screws. The two wheels have broad treads which permit the truck to be pushed with ease over comparatively rough surfaces and easily guided in any direction necessary to pass around trestles, ladders, or other obstructions in the passageway even though it may be somewhat narrow. A handle is provided for use when the truck is not loaded. This arrangement is simple, cheaply and easily constructed and should be of use at many freight car repair points.



One Man Can Handle Easily One or Two Doors

The Directors of the Chicago, Burlington & Quincy have authorized a pension plan for the employees of that road. Prior to the announcement of the plan, a study is being made of the pension systems of other roads.

Actual and Ideal Boiler Plant Efficiency*

Avoidable Wastes Are Pointed Out, and a Desirable Standard of Boiler Construction and Operation Recommended

By Victor J. Azbe
Consulting Engineer, St. Louis, Mo.

THE degree of waste in boiler plants is not generally realized and there is a tendency to judge conditions by a few of the better plants where improvements have been made and whose results are considered as representative of the average run of boiler plants.

Tables 1 and 2 show two boiler tests made under ordinary operating conditions, one on a hand- and one on a stoker-fired boiler. During these tests care was taken that actual operating methods were pursued. The results are very bad but representative of most smaller and some of the larger installations.

Table 3 gives the results of three boiler tests, all made on the same boiler some time apart. The boiler was of the B. & W. type, but poorly set, with a limited combustion chamber of only 0.87 cu. ft. per rated boiler hp. The stoker in use was of the old Jones type.

During Test A the aim was to maintain the same operating conditions as existed before any improvements were made; the result was an efficiency of 56 per cent and boiler rating of 102 per cent. After this first test improvements were begun, without, however, altering the stoker or increasing the combustion space.

After about six months, results were obtained as represented by Test B in Table 2; the efficiency was increased to 68.5 per cent and capacity to 140 per cent of rating. The results were not as yet considered satisfactory and efforts for further improvement were made. In all about 30 boiler tests were run under different conditions and with different fuel and one of the last tests is represented by Test C in Table 3. This last test is very remarkable in several respects, but is correct. In fact, the results are checked by other tests giving equal or even slightly better results.

The remarkable features of the results of this test are as follows:

(1) High boiler efficiency with a relatively inefficient installation and relatively poor coal.

(2) Complete combustion with high volatile coal and a combustion space of only 0.47 cu. ft. per developed boiler hp. or 0.11 cu. ft. per lb. of coal including the space occupied by the coal.

(3) A draft drop through a 16-section, 9-tube (each 16 ft. long) B. & W. boiler of only 0.1 in. at 85 per cent overload.

(4) A flue-gas temperature of 532 deg. Fahr. at 85 per cent overload in spite of the limited combustion space and flame extension to almost the end of the first pass.

(5) An improvement of 39.5 per cent in economy over that of Test A.

(6) An improvement of 81.4 per cent in capacity over that of Test A, in spite of the fact that during the first test maximum boiler rating was aimed at. Other examples could be enumerated of great improvements being made.

Standard of Economy

The writer considers 90 per cent efficiency as the standard of economy attainable under favorable conditions, this 90 per cent representing boiler and economizer without taking auxiliary power into consideration, however. The requirements for this efficiency are rather severe and with 12,000 B.t.u. bituminous coal, 15 per cent excess air would have to be used; flue-gas temperature would have to be no more than 250 deg. Fahr.; combustion complete and no carbon in the ash. These requirements are listed in Table 4.

TABLE 1—TEST ON HAND-FIRED BOILER REPRESENTING VERY UNECONOMICAL CONDITIONS

Date of test	Dec. 2, 1920
Type of boiler	B & W
Grate	Shaking
Kind of Coal	Illinois screenings
Steam pressure, gage, lb	135.6
Temperature of feedwater, deg. Fahr	205.0
Temperature of flue gas, deg. Fahr	568.4
Draft at back damper, in	0.48
Draft over the fire, in	0.24
Carbon dioxide, per cent	5.68
Quality of steam, per cent	98.5
Rated boiler h.p	150.0
Per cent of rated capacity developed	105.9
Evaporation, equivalent, coal as fired, lb	4.91
Evaporation, equivalent, coal dry, lb	5.51
Calorific value of coal, dry basis, B.t.u	11510
Coal analysis, per cent: Moisture	10.9
Ash	15.8
Volatile matter	35.2
Fixed carbon	38.1
Carbon in ash, per cent	24.4
HEAT BALANCE	**Per cent**
Heat absorbed by the boiler	45.31
Loss due evaporation of moisture in coal	1.31
Loss from vapor of hydrogen combustion	5.41
Loss in dry flue gas	28.21
Loss due to carbon monoxide	4.24
Loss due to combustible in ash	5.40
Loss due to heating of moisture in air	0.30
Loss due to radiation, hydrogen, hydrocarbon, etc	9.22

*From a paper presented at the annual meeting, New York, December 5-9, 1921, of the American Society of Mechanical Engineers.

TABLE 2—TEST ON STOKER-FIRED BOILER REPRESENTING VERY UNECONOMICAL CONDITIONS

Date of test	Feb. 23, 1917
Type of boiler	Heine
Type of grate	Detroit
Kind of coal	Pocahontas nut & slack
Steam-pressure, gage, lb	138
Temperature of feedwater, deg. Fahr	152
Temperature of flue gas, deg. Fahr	761
Draft at back damper, in	0.98
Draft over fire, in	0.38
Carbon dioxide, per cent	8.1
Coal burned, lb	14,700
Water evaporated, lb	96,480
Evaporation (actual), lb	6.56
Evaporation (equivalent), lb	7.25
Boiler h.p. developed per hr., lb	386.6
Boiler rating, h.p.	328
Per cent of rating developed	118
Heat value of fuel, B.t.u.	13,950
Boiler efficiency, per cent	50.4

TABLE 3—BOILER TESTS REPRESENTING IMPROVEMENT OF BOILER PERFORMANCE

Test[1]	A	B	C
Type of boiler		B & W	
Type of stoker		Jones	
Kind of coal		Illinois screenings	
Steam pressure, gage, lb	130	127	129
Temperature of feedwater, deg. Fahr	180.6	187.0	176.8
Temperature of flue gas, deg. Fahr	612	533	532
Draft at back damper, in	0.57	0.34	0.11
Draft on fire, in	0.45	0.24	0.01
Forced-draft pressure, in	3.00	3.52	4.04
Carbon dioxide, per cent	7.6	13.3	14.0
Quality of steam, per cent	0.991	0.991	0.990
Rated boiler h.p.	269	269	269
Per cent of rated capacity developed	102	140	185
Evaporation, equivalent, coal as fired, lb	6.14	8.19	8.43
Evaporation, equivalent, coal, dry, lb	6.95	9.05	9.55
Calorific value of coal, dry basis, B.t.u.	12,080	12,850	11,864
Coal analysis, per cent: Moisture	11.7	9.9	11.7
Ash	13.4	8.9	12.5
Volatile matter	31.0	32.2	32.5
Fixed carbon	43.9	49.5	43.3
Carbon in ash, per cent	16.7	19.4	17.2
Efficiency of boiler furnace and grate, per cent	56.0	68.5	78.1
Improvement in economy over Test A, per cent	.....	22.3	39.5
Increase in capacity over Test A, per cent	.....	31.4	81.4

[1]Test A indicates conditions when no effort toward economy was made, while Tests B and C show gradual improvement under an economy campaign. In all three cases maximum possible capacity was striven for.

TABLE 4—IDEAL BOILER AND FURNACE PERFORMANCE

Kind of fuel	Bituminous coal
Heat value of fuel, B.t.u. per lb	12,000
Moisture of fuel, per cent	10
Hydrogen in fuel, per cent	3.5
Theoretical air per lb., lb	8.98
Excess air, per cent	15
Actual air per lb., lb	10.33
Flue-gas temperature, deg. Fahr	220
HEAT BALANCE	Per cent
Loss due to dry chimney gas	3.15
Loss due to moisture from H_2O	2.85
Loss due to moisture in coal and air	1.00
Loss due to carbon in ash	1.00
Loss due to incomplete combustion	0.00
Loss due to radiation and conduction	2.00
Total loss	10.00
Boiler efficiency	90.00

This ideal, or 90 per cent boiler and furnace efficiency, has been attained only once, and then by Henry Kreisinger and John Blizard at the Lakeside Station of the Milwaukee Electric Railway & Light Co.

Fuels

With a suitable installation, almost as high an efficiency will be obtained with low- as with high-grade fuels. The obstacle is the tendency toward a greater ashpit loss.

As a rule low-grade fuel should be burned close to the mines and higher-grade fuel transported. Freight and fuel costs should be based on heat value rather than weight.

Combustion

There are several reasons why properly proportioned furnaces with ample combustion space are necessary, the most important being the prevention of escape of unburned gas and formation of soot, the possibility of operating with the least amount of excess air without incomplete combustion, and the prevention of flame entrance among the boiler flues. The last is necessary to obtain low flue-gas temperatures.

Furnace volumes vary from 1 cu. ft. per lb. of coal burned per hr. down to less than 0.1 cu. ft. in some cases. The lower amounts, of course, do not represent the entire combustion space because combustion under such conditions extends among the tubes, at times for a considerable distance, but this is not what is to be desired. The larger amounts are used with powdered fuel and are necessary because the solid particles burning are relatively large and require a larger combustion chamber for their gasification and combustion than is the case when gasification, and to a certain extent mixing with air, takes place on a grate.

The aim is to have the gas completely burned and no flame entering the first tube pass. To accomplish this, more than mere furnace volume is necessary.

Excess Air

The largest preventable loss in boiler plants is that caused by excess air. Determination of this loss by the measure of the CO_2 and flue-gas temperature has achieved considerable popularity. Where such popularity has been attained, the trouble is, however, that quite generally there is satisfaction if the fuel is burned with 100 per cent excess air, and even in well-operated plants no better results are obtained on the average. This is because of the tendency of many an engineer to assume statements as correct without sufficient consideration. With the large combustion chambers coming in vogue nowadays the old assumption that 10 or 12 per cent CO_2 is all that pays becomes obsolete. If we design our furnaces so that flame terminates before gas enters the tubes or soon thereafter and with the boiler heating surface so exposed that the maximum amount of heat is radiated to it, then the standard of good performance is the burning of the fuel with 15 or at the very most 25 per cent of excess air, and the CO_2 maintained should be around 16 per cent.

The point at which excess air enters is very important and should be given greater prominence when boiler-test data are recorded. At present during a test we tend to be primarily concerned with what occurs on the ends; that is, in the furnace and uptake, and few, if any, observations are taken and records made of what occurs between these points. Such items as point of flame termination, relative amount of oxygen, carbon dioxide percentage (which is a true measure of excess air), and temperature drop at various points through the settings, should be carefully recorded and interpreted; then it will be possible to really compare the performance of one boiler with another.

A somewhat overlooked but also very important factor affecting boiler plant economy is "constancy." The percentage of CO_2 may fluctuate during the day from high to low, but if for the whole day a 10 per cent average is taken, it will be found that for a number of reasons the efficiency will not be nearly so good as when 10 per cent of CO_2 is constantly maintained. Therefore the average CO_2 is an improper measure of the loss, but is an indicator of conditions.

Heat Transfer and Flue-Gas Temperature

The temperature of the escaping products of combustion determines fuel loss to a great extent, but what is low and what is high flue-gas temperature? The lack of a suitable measure and standard has in the past prevented proper comparison of results and has also caused a certain lack of incentive for improvement. The writer, in his effort to evolve a measure, has drawn Fig. 1 based on 150 different boiler tests. Each dot represents the average flue-gas temperature at the average rating developed in each test. The space is divided into sections varying from exceptionally good to exceptionally bad results, with the slope of the line following as closely as possible the increase of flue-gas temperature with the increase of boiler output of a number of tests.

To absorb the heat, it is necessary to bring the gas in contact with the heating surface. This some boilers do imperfectly. If the surface is clean everything depends upon gas velocity and distribution. Fig. 2 shows what happens under certain conditions. In the dead spaces temperatures as low as 380 deg. Fahr. were recorded when the flue-gas temperature was 680 deg. Fahr. The gas has the tendency to take

the shortest cut, a great deal like a stream of water; in fact, much might be learned from the study of water stream flow which could be applied very profitably to boiler-pass design.

Boiler Capacity

When boiler capacity is increased by the burning of more

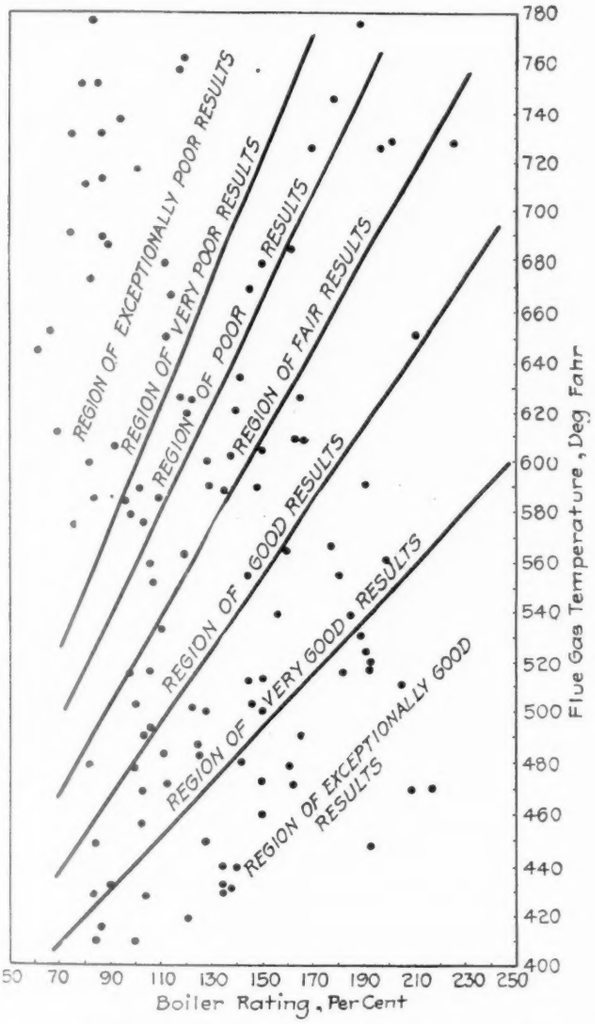


Fig. 1—Flue Gas Temperatures Representative of Good and Bad Results

fuel, the following either does or may occur:

(1) Temperature in combustion chamber increases.

(2) Temperature of gas throughout boiler setting increases.

(3) Temperature difference between water in boiler and gas surrounding tubes and drums increases.

(4) Gas velocity increases.

(5) Heat absorption by radiation increases owing to higher furnace temperature.

(6) Heat absorption by convection increases owing to higher gas velocity and higher temperature difference.

(7) Flue-gas temperature increases.

(8) Dead spaces become more active.

(9) Incomplete combustion increases.

(10) Fuel loss resulting from air in leakage and radiation expressed as a percentage of total decreases.

(11) Excess air decreases.

(12) Fireman's attention usually increases.

(13) Return received from investment increases.

There are several factors in this list that counteract each other, some increasing and others reducing efficiency, but as a balance, within limitations, increased boiler capacity is more economical.

It is the writer's experience that the very large majority of plants possess and operate too many boilers, at times twice as many as necessary. The cry is, "Give us plenty of boilers," and the result is waste in investment and waste in operation.

Since high boiler efficiency at low ratings is more difficult to obtain than at high ratings, it follows that owing to this and also for investment reasons, boilers should be installed designed for high overloads and high and constant efficiency over a considerable capacity range. Especially in plants where the load varies a great deal the boilers should be able

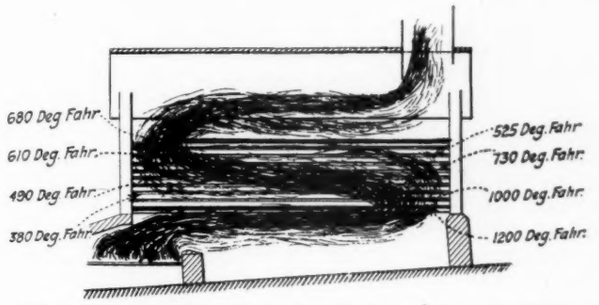


Fig. 2—Unequal Gas Flow Distribution Through a Boiler

to take the peaks; even if these peak loads are somewhat uneconomical they are to be preferred to boilers loafing the greater part of the time. As a rule good boilers, well installed, should be operated at between 150 and 200 per cent of rating, and when a peak is of short duration 300 per cent of rating is permissible. Ratings below 150 per cent should not be permitted except under unavoidable circumstances.

Features of an Ideal Boiler Installation

It may appear to some that the boiler with its appurtenances has been developed to what might be called the limiting point; this, however, is not so. There remains an immense field for experimental research to obtain the necessary data for boiler construction.

The ideal boiler installation should embody the following:

(1) A construction permitting counterflow where flue gas will heat the feedwater which will enter the boiler at as nearly the steam temperature as load fluctuations will permit.

(2) A combustion chamber sufficiently large and effective throughout to prevent the entrance of any flame among the tubes, thus assuring complete combustion, absence of soot, and proper cooling of the gas.

(3) Boiler passes which will be effective throughout without dead spaces where there is no gas flow or only little, and in which the draft drop will be the minimum corresponding to gas velocity. The gas velocity will be the highest permissible by the cost of producing this velocity.

(4) Fuel resistance will be overcome by forced draft.

(5) The relative location of fire bed and boiler-heating surface is to be such that the maximum possible amount of radiant heat will be transmitted to the boiler surface consistent with complete combustion.

(6) Tight boiler walls properly insulated, probably an air-jacketed furnace, the air from which will be injected over the fire bed at high velocity to aid mixing effect or passed through the grate in the ordinary way.

(7) A stoker permitting combustion with no more than 15 to 25 per cent excess air, no more than 1.2 per cent unburned carbon in ashpit, no deposit of slag on the tubes and these conditions maintained at low and high ratings.

(8) Scale deposit prevented by specially constructed self-cleaning boiler, external chemical treatment of feedwater, use of distilled makeup water, filtering of the water in the boiler by recirculation or by a combination of these methods.

Selection of Railroad Shop Machine Tools

A Description of Types Best Adapted to the Principal Machine Operations; Importance of Grinders Stressed

By M. H. Williams

IN the near future it is to be hoped that financial conditions will enable the railways to purchase needed additional machine tools. As the larger railway repair shops are developing quantity manufacturing methods, it follows that the most modern, productive machines should be carefully considered in order to ascertain if they will be a profitable investment. Below are mentioned a number of machines commonly used in manufacturing plants and also in a few railway shops where their installation has resulted in greater production, reduced cost of machining, better finish, or a combination of all three advantages.

It will be noted when going over the lists of machines that many are more or less strangers in railway shops and at first glance they may appear too far advanced for the work required. However, in railway shops where a modern, semi-special machine is installed the work will in time grow up to the machine. That is, new uses are continually found for machines having great productive capacity and it is surprising, after installing a new class of machine such as a grinder, milling machine, or automatic, to note how soon new uses are found for these machines and how the work will pile up around them; also how soon additional machines will be asked for owing to the transfer of work from obsolete types.

Plain Knee-Type Milling Machines

No attempt will be made to explain in detail the machines referred to in this article, but it is hoped to outline their

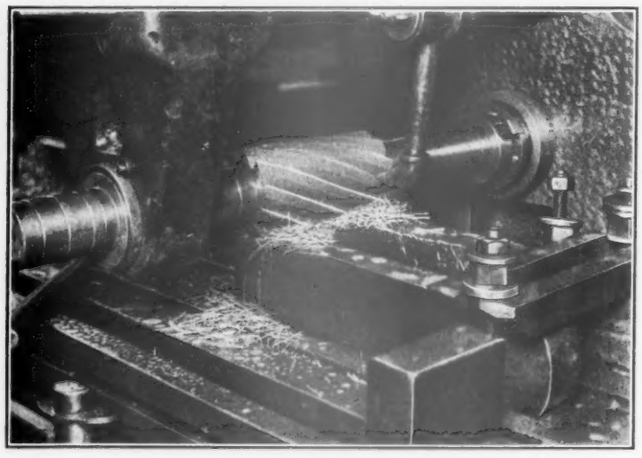


Fig. 1—Modern Plain Knee Type Miller "Producing" a Valve Motion Lever

advantages and respective fields of usefulness. The large, plain, knee-type milling machine is one of the tools that should receive first consideration and along with it the question of fixtures for holding various articles on the machine when milling. With the No. 5 horizontal machine (Fig. 1), using coarse-tooth, high-speed steel cutters, parts such as pedestal shoes, rod wedges, valve gear levers, etc., are readily milled with a feed of 3 to 12 in. per min., the rate of feed being principally a question of how securely a part can be held on the machine table or in the fixture. As far as the cutters are concerned the later designs will generally stand all that the holding devices will. As an illustration, pedestal wedges 18 in. long by 4 to 8 in. wide are milled in three minutes per side. Adding to this 5 min. per side to place in and remove from the fixture, the total time for the two sides is 16 min. When milling the edges, four wedges are set up at one time and milled at the same rate of feed. This makes the time to mill the two edges and clamp 4 min., or a total of 20 min. per wedge. This time is often reduced where a fixture holding two wedges, one after the other, is used.

The flat surfaces of valve gear levers are readily milled with ordinary cutters. The different fillets can be made readily by the use of cutters of the same diameter as the

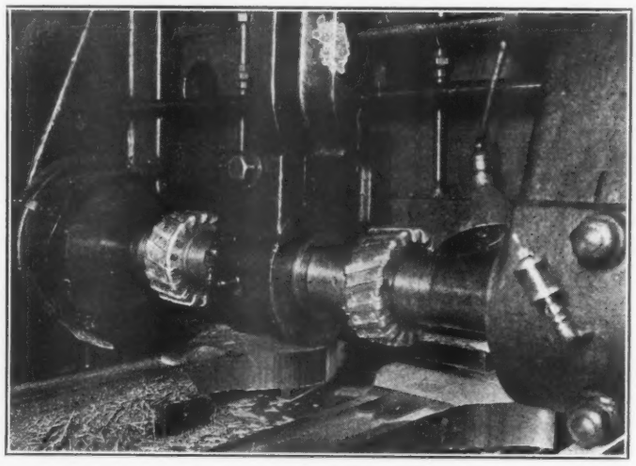


Fig. 2—Powerful Slab Milling Machine Used for Channeling Rods

fillet, the result being that the entire outside surfaces of the levers are finished from rough forgings to the finished sizes on this machine. In addition, the insides of the jaws can be milled from the solid forging by the use of small diameter, steep pitch, coarse tooth, milling cutters. Levers can be finished using a 3-in. feed on the plain flat surfaces and a ¾-in. feed when forming the insides of jaws. Forming the fillets on a milling machine will show considerable advantages over previous planer and slotter methods. The surfaces left by the milling cutters are usually smooth enough to meet all requirements for work on freight locomotives and with a small amount of grinding will meet the requirements for locomotives in passenger service. It can be said without fear of contradiction that a valve rod should never go on a planer, shaper or slotter.

When milling rod keys it is primarily a question of the time taken to clamp and remove the parts from the machine. With proper fixtures for holding, these can readily be milled at the rate of 3 to 6 in. per min. As a result the time per face will be from 2 to 4 min.

The above mentioned uses for this class of machine are only a small proportion of what will develop after their installation. One point should be borne in mind; a modern milling cutter in a heavy, rigid machine will as a general rule mill a surface sufficiently flat and true in one cut to meet the requirements for railway work. Whether the surface be wide or narrow makes but little difference as far as the rate of feed is concerned.

With the plain knee-type milling machine the output is governed largely by the type of holding fixtures used. Under most conditions the time required for loading and unloading articles is actually greater than that required for the milling. Therefore, the more suitable and handy the fixtures, the greater the output and correspondingly the fewer milling machines required. It is economical to provide special holding fixtures for the articles more frequently required. The manufacturers of milling machines are always ready to help out on the designs of these fixtures; therefore, when considering the purchase of a machine, it is well to obtain the benefit of their service department by sending prints of what is required to the machine builder.

Fig. 3—Heavy Vertical Miller and One of Its Common Uses

Slab and Large Vertical Millers

The flat surfaces of main rods and side rods should in all cases be milled in preference to planing. With slab milling machines of the larger type such as the 48 in. by 48 in. by 16 ft., two main or side rods can be milled on their flat surfaces at one time. From four to eight may be milled on the sides at one time, or two rods can be fluted at one time (Fig. 2). These rods are readily milled when feeding 1 to 3 in. per min. In addition to machining the flat surfaces the rods are milled around the bosses to required shapes and sizes.

A milling machine for the above purpose should not be a light toy but a powerful machine, strong enough to work milling cutters to their limit and under favorable conditions of heavy loading consume 80 hp. To set up rods on this machine takes no longer than on a planer; in fact, with a machine bed of ample length, one set of rods is often set up on one half of the bed while milling on the other half, thus reducing the idle time below that possible on a planer. The milling machine has the advantage that the straight, flat surfaces and also the bosses or fillets can be finished at one set up; also, the surfaces are generally smoother than when planed. The time required is about 50 per cent less when milling as compared with planing.

For milling the radius around the rod bore and forming fillets the larger vertical milling machine (Fig. 3) is used. With machines of this type one large or two small rods are readily machined at one time at feeds of ½ to 1 in. per min., depending largely on the amount of metal left on the forging. This machine is also used for milling the edges of links and link blocks and much other miscellaneous work; also surfaces that are difficult to mill on the slab millers. It can generally be said that the ends of two rods can be milled in the time taken to slot one rod.

Vertical Knee-Type Milling Machines

The jaws of main rods or straps for holding the front and rear brasses are readily milled on the large vertical type milling machine (Fig. 4). For this work the open end jaws are milled by feeding the milling cutter directly into the solid forging cutting on one side of the jaw, then going across the end of the jaw and finally back on the opposite side, thus removing the block. After this, the surfaces are gone over with the same cutter for the finishing and sizing operations. For closed jaws such as are common in many main rods a clearance hole is drilled for entering the milling cutter, after which the jaw is roughed and finished as above described. This method of machining eliminates drilling, sawing and slotting for removing the central block of metal and makes it possible to finish these jaws in one set up on the machine, to the correct size and with a smoother finish than is obtained on the slotter. Plowing into a rod with a milling cutter does not present any difficulties where the coarse tooth, high spiral cutter is used, the cutter being well supported at the lower end. This form of cutter, throwing out chips from the slot, prevents clogging as is the case with cutters of the ordinary form.

In order to operate milling machines to their fullest capacity it is necessary to keep the milling cutters sharp, so cutter grinders (Fig. 5) should be installed in tool rooms for the uniformly correct grinding of all milling cutters.

There is an important question in milling versus filing rod brasses. The work of fitting main rod brasses to rods probably will be ever with us; these brasses are getting larger and larger and the filing is becoming more difficult from day to day. The work of filing brasses can be eliminated by the use of the plain knee-type milling machine and proper fixtures for holding the brasses. With these, the brasses are milled to the correct size to fit the rods, a comparatively simple operation that does not require unusual workmanship.

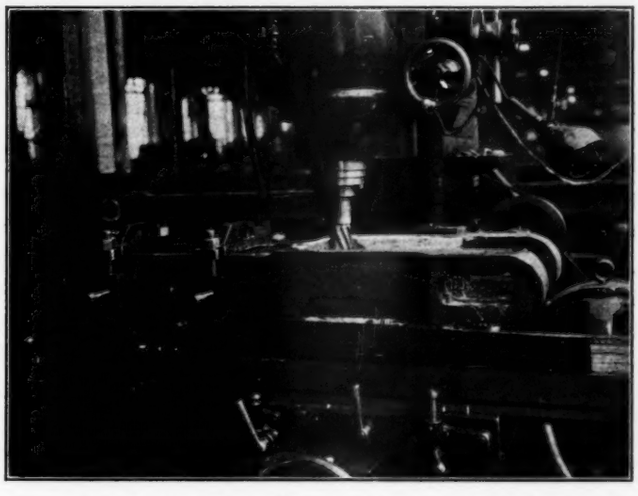


Fig. 4—The Vertical Knee Type Machine with Cutter Supported at Lower End Takes Heavy Cuts

Increased Importance of Grinding Machines

If milling machines are essential to efficient shop operation so also are grinders. In the railway shop of the future

every smooth or bearing surface that can be reached by a grinding wheel will be finished by grinding, otherwise the maximum economy in machine operations will not be realized. Today it is the common practice in most manufacturing plants to finish all possible surfaces in this manner and this practice will sooner or later be followed in every railway shop. Many car and locomotive parts can be roughed out on heavy production machines but the use of the grinding process for finishing operations possesses advantages over any other method. Smooth finish, accurate sizes and rapid machining are features of the work done on modern grinding machines. It may be said that files and emery paper should be eliminated as a means of securing highly finished surfaces.

Plain Cylindrical Grinders

The locomotive piston rod of the future will be blanked out about 1/32 in. large by taking the coarsest feed the lathe will stand. The rod will then be transferred to a grinder and finished on both the straight and taper surfaces. This will result in a finish more uniform than filing and at a reduced cost. Valve rods will be treated in a similar manner. Crosshead pins and crank pins will be blanked out on turret lathes or automatic chucking machines and finished by grinding. Knuckle pins and valve motion pins and bushings

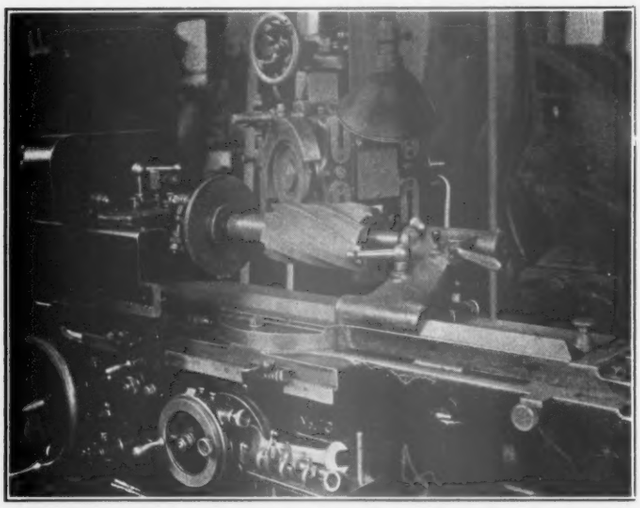


Fig. 5—The Universal Cutter Grinder—An Essential Shop Tool

will be blanked out on automatic machines, ground to a semi-finished state and finally finished to the required size on grinding machines at the time of making repairs to the locomotives. Locomotive and car axles will be roughed out on lathes and ground (Fig. 6) to the finished sizes as in making piston rods. In fact every bearing surface coming within the range of plain cylindrical grinders will be finished on these machines.

The plain cylindrical grinder of the future will be a hog for work and, as a result, surfaces will be finished quickly. The smallest grinder for railway work, namely, the 10 by 36 in. size, has sufficient strength and rigidity to consume at least 15 hp. This size is used for grinding smaller articles such as valve motion pins and bushings, side rod knuckle pins and bushings, crosshead pins, etc. For larger work such as piston rods, axles, large crank pins, etc., these machines should be about 20 by 120 in. and consume 40 hp. Piston rod grinding machines have been installed in several railway shops and generally proved the value of grinding as compared to other methods of finishing. With up-to-date machines, the diameter of rods can be reduced 0.002 in. at each pass of the wheel and with a feed of 1½ in. per revolution of the rod. This serves as a basis for calculating the possibilities of grinding.

Moreover, it is to be hoped that some day the grinder manufacturers will bring out a machine to grind the journals of locomotive axles with the wheels mounted, this method to be substituted for the present practice of turning and burnishing. There is a demand for a machine of this nature owing to the superior finish, more accurate work, and the fact that the diameter of the axle will be reduced a minimum amount.

Surface Grinding Machines

The work of refinishing flat surfaces such as the sides of main rods where worn at the jaws, the surfaces of new rods

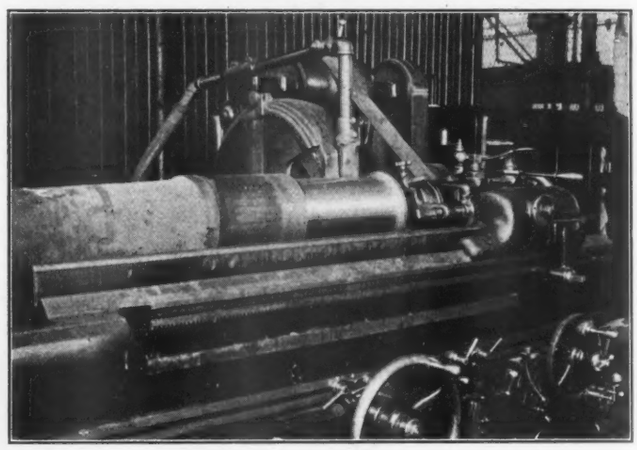


Fig. 6—High Power Cylindrical Grinder Truing a Trailer Axle

where a smooth surface is required, surfaces of guide bars, the sides of links and link blocks, sides of large washers used on side rods made from boiler steel and finished on their flat side, will be finished on surface grinders (Fig. 7), the work being held by magnetic chucks in order to reduce the time of set up. These grinders are now available, of heavy construction, requiring about 40 hp. to run and as a result the time required for setting up and finishing a surface is small when compared with planing, filing and polishing with

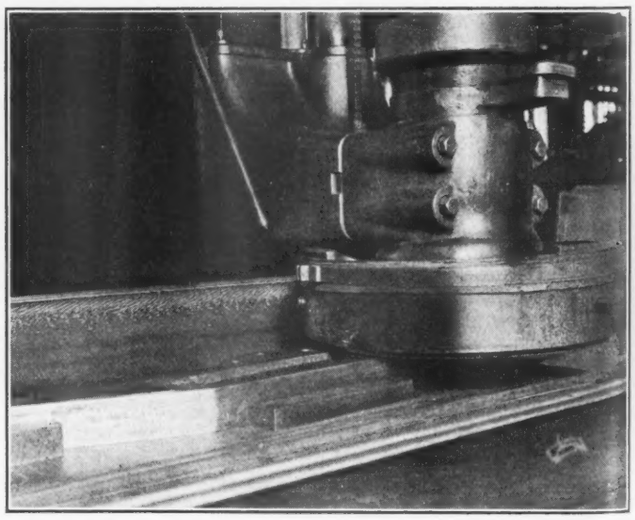


Fig. 7—Surface Grinder, Equipped with Magnetic Chuck Finishing a Link.

emery paper. It is surprising to note the number of car and locomotive parts with flat surfaces that can be ground to good advantage; therefore, the surface grinder is one of the machines that should receive more careful attention in the future than it has been given in the past.

Planetary and Chucking Internal Grinders

The planetary internal grinder (Fig. 8) is almost indispensable in railway shops, being used for truing the holes for bushings in valve motion levers and side rods, the bores for pins in link blocks, truing brass bushings used in air brake triple valves, feed valves and similar articles, regrinding air pump cylinders, valve chamber bushings, etc. With this class of machine the bore of levers, rods and other articles can be ground practically true in a fraction of the time required for boring, at the same time producing much smoother work. This machine not only becomes a money saver but also results in superior work. The automobile companies have set a pace for doing work on this machine that the railways should endeavor to follow.

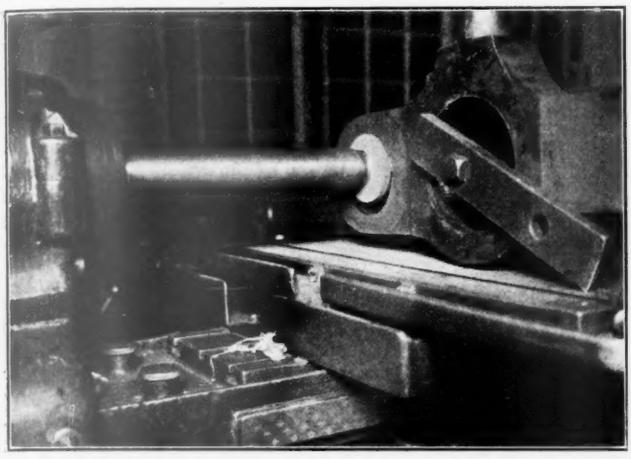


Fig. 8—No Machine Equals the Planetary Internal Grinder for Truing Holes

The chucking grinder is used to a limited extent in railway shops and extensively by manufacturing concerns. Where used it has proven of great value and should receive careful consideration. This machine is used for grinding the bores of knuckle and valve motion bushings and other articles where a true and accurate internal bearing is necessary. It can not be considered a luxury but is a money saver purely from the manufacturing point of view, owing to the fact that when blanking out articles, less time is consumed. It is not necessary to maintain close sizes which results in a greater output of automatic or turret lathes, the general scheme where these machines have been installed being to blank out the articles fairly close to size and then grind the bearing surfaces to exact gage sizes. This results in more accurate work, and in addition has the advantage that casehardened bushings can be ground true and the warping due to casehardening eliminated. This country is noted the world over for the interchangeability of parts going to make up completed machines, and this interchangeability has been brought about largely owing to the use of grinding machines. If the manufacturers that are in the business to make money find grinding a paying proposition the process must possess merits that railway men cannot afford to ignore.

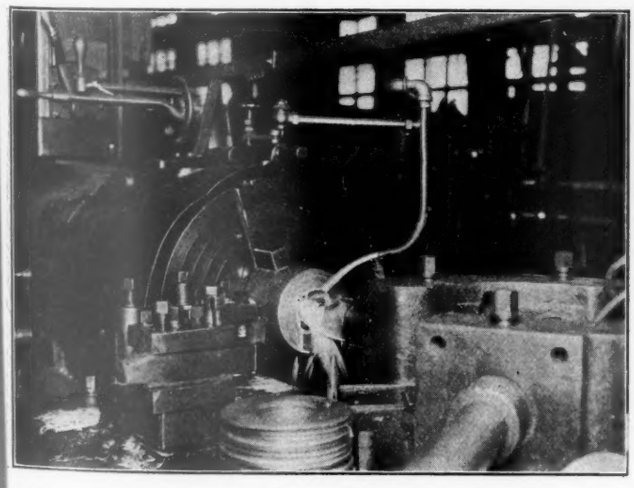


Fig. 9—Powerful Turret Lathe Machining Crank Pin Collars

Use of Heavy Turret Lathes

The large turret lathes (Fig. 9) are desirable machines for railway shops as they machine castings and forgings too heavy for the automatics much more quickly than can be done on regular lathes.

In order to obtain the full output from turret lathes, it is necessary to equip them with suitable fixtures such as box tools, bar turners, dies, etc. By the use of these fixtures it is often possible to arrange the work so that two or more tools are cutting at one time and as a result the rate of output is greatly increased. The makers of turret lathes generally maintain a service department and will gladly supply data and drawings for tooling for any job desired, thus enabling railroad shops to install an up-to-date outfit at the start and avoid a lot of expensive experimenting on small tools and delays to machines. In other words, it pays to pay the other fellow for what he has designed and not pay the local force for what the other fellow can do better and cheaper.

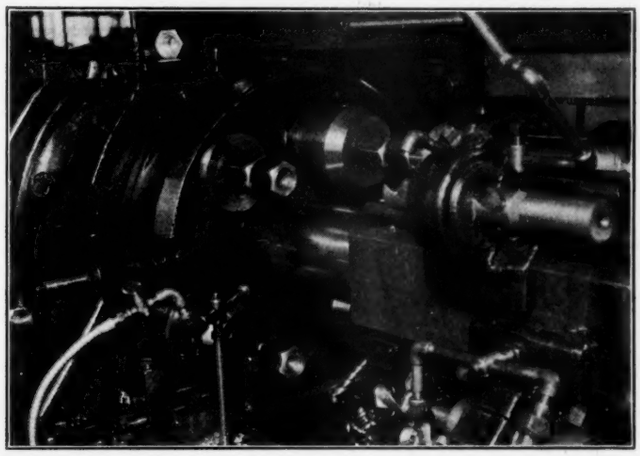


Fig. 10—Modern Automatic, Unequalled for Production of Duplicate Parts

Automatic Screw Machines

The automatic screw machine (Fig. 10) and automatic chucking machines have proved their value in railway shops, the smaller screw machines being used for articles required in moderate quantities such as are made from bar stock and the chucking machines being used principally for finishing castings and forgings. As a general proposition it may be said that one man on an automatic will produce as many articles per day as three men on center lathes, or the hand-operated turret lathe. When considering the cost of machine tool equipment per unit article required, the automatics are in most cases the cheaper, and should be selected wherever there is a reasonable possibility of keeping them busy.

In some railway shops practically all valve motion bushings and pins are made on automatic screw machines from bar stock at a cost very much less than when made on other machines. The chucking machines are used for machining forgings and castings such as knuckle pins and bushings, crosshead pins, air pump piston heads, globe valves, or in fact any article within the capacity of the larger machines.

Bending Center Suspension Brackets

By Wesley J. Wiggin

Asst. Blacksmith Foreman, Boston & Maine, Billerica Shops, Mass.

A former for bending center suspension brackets is shown in the illustration and has demonstrated its value in the quantity production of these parts. The brackets are made of spring steel on the device shown in Fig. 1, the sequence of operation and former details being shown in Fig. 2.

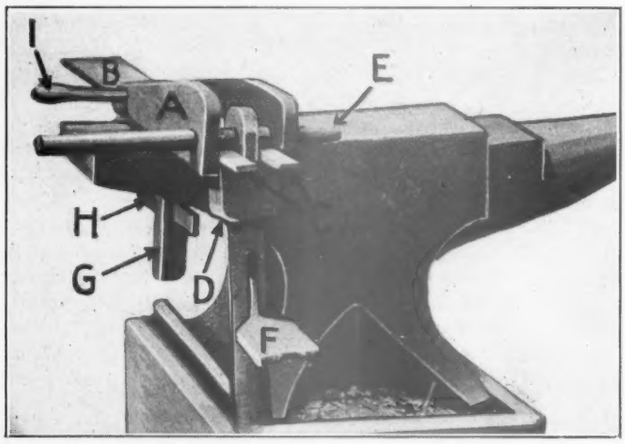


Fig. 1—Former and Bracket Before Bending

The first operation is to punch the two holes and slot on an 18-in. double punch and shear; the bracket after this operation being shown in the upper left corner of Fig. 2. The second operation consists of forming the eyes and the third, making a double bend to form the finished bracket. Referring to Fig. 1, a view is given of the bracket and former at the beginning of the second operation. The former *A* is attached firmly to the anvil by means of projecting part *G* and taper key *H*. Bracket *B* is inserted in the former with ends *C* projecting beyond the swinging arm *D* which is pivoted on pin *E*. It is evident that the revolution of *D* will bend ends *C* around the ¾-in. pin *E*, forming the eyes of the bracket. The dog *F* is used in the latter part of the second operation to insure ends *C* fitting accurately around the pin *E*.

During the third operation both bends are made in the bracket with one heat by means of formers *J* and *K*, former *J* being fastened in *A* by means of pin *I* (Fig. 1). The pin hole in *J* is located so as to bring the bends at the proper points and it will be noted that the two holes enable two different sized brackets to be made. The two bends in the bracket are made simultaneously between formers *J* and *K*, using light blows of a sledge hammer and thus the bracket is completed ready for service. Any number of brackets, all alike as to relative location of ¾-in. bolts, holes and bends, can be made with this device and with a considerable saving in time over what would be required to do the work without it.

Polishing Tap and Reamer Flutes*

Flutes of reamers, taps, and other similar small tools are not usually polished in regular production work, but are only ground with solid wheels. For that operation Norton Alundum wheels, 2 in. to 6 in. in diameter by ¼ in. to ½ in. thick, grains 60 or 80, grades O to Q, have been found satisfactory.

However, some manufacturers do polish the flutes of taps and reamers; and for that work a felt or leather wheel is generally used, unless the work is extra large, when a canvas wheel is better, since it will hold the abrasive better and give greater production. On the smaller sizes a leather wheel is considered best from the cutting standpoint, while it is as good as other kinds for finish. These are made from

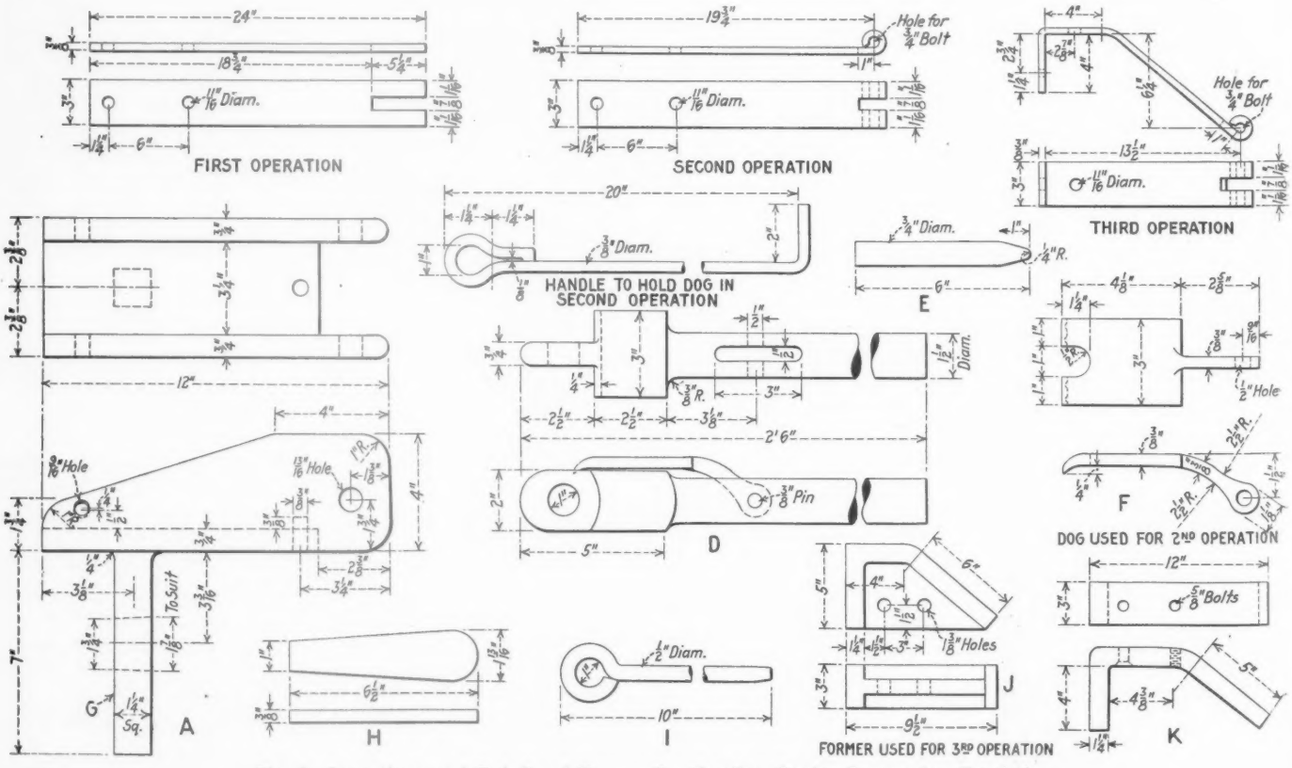


Fig. 2—Operations and Details of Former for Bending Center Suspension Brackets

*From Grits and Grinds.

good quality of oak tan leather. Such wheels should be approximately 6 in. or 8 in. in diameter by ¼ in. or ½ in. thick.

Care should be taken to see that the polishing wheel is true and if necessary it should be turned true before setting up with grain. When this is done a sizing of good glue should be applied and left about two hours to dry. Then two coats of glue and abrasive are put on and left to dry over night. Before using, the grain on the sides of the wheel should be dressed off with a piece of broken grinding wheel, so that it cannot cut the edges of the work being polished.

The sizes of wheels and also the grain to use depend largely upon the sizes of the work. For the large work grain 60 or 80 is good, while for smaller sizes about 120 or 150 is satisfactory. If a still better finish is required, grain 200 with Tripoli or oil can be used.

This work is all done free-hand and is considered quite difficult. It sometimes takes even as long as a year to train a man so he will make an efficient polisher of this class of work.

Standards of Railroad Shop Welding Practice*

General Rules Together with Typical Examples of Welding and Building Up Worn Parts Are Included

By G. M. Calmbach
Welding Engineer

IN making heavy frame welds with gas it is essential that the parts be carefully cleaned and prepared for welding by cutting the ends to the proper angle and making necessary allowance for contraction in cooling. It is also wise, wherever space permits, to build up the weld a certain proportion larger than the original cross section in order to provide additional strength.

The standard method of cutting, welding and reinforcing bolsters, truck side and engine frames, and all other steel, iron, or cast steel from ¾ in. to 8 in. in thickness is shown in Fig. 1 and the accompanying tables. The amount of reinforcement provided is a certain proportion of the cross section decreasing in amount as the size of the section increases. It will also be noted from the tables that the angle to which the broken parts are cut or Ved varies from 45 deg. to 55 deg., all sections over two inches thick being Ved and welded from both sides.

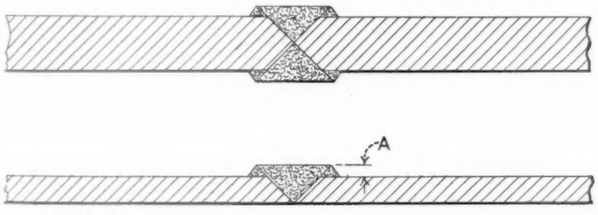


Fig. 1—Cross Sections of Standard Welds Showing Single and Double Reinforcement

STANDARD REINFORCEMENT FOR ALL HEAVY WELDING

Thickness of Material	Proportional Increase in Thickness
¾ in. — 1½ in.	A = 25 per cent
1½ in. — 2½ in.	A = 15 per cent
2½ in. — 4 in.	A = 10 per cent
4 in. — 6 in.	A = 7 per cent
6 in. — 8 in.	A = 5 per cent

STANDARD V FOR HEAVY WELDING

Thickness of Material	Angle of V
¾ in. — 1½ in.	One side — 45 deg.
1 in. — 2 in.	One side — 55 deg.
1 in. — 2 in.	Both sides — 45 deg.
2 in. — 3 in.	One side — 50 deg.
2 in. — 3 in.	Both sides — 55 deg.
3 in. — 4 in.	Both sides — 55 deg.
4 in. — 5 in.	Both sides — 55 deg.
5 in. — 6 in.	Both sides — 55 deg.
6 in. — 8 in.	Both sides — 55 deg.

*The second of two articles on railroad shop welding practice by this author. The first article appeared on page 772 of the December *Railway Mechanical Engineer*.

Preparation for Frame Welding

As in the usual practice the frame to be welded is lined up, trammed and checked with the opposite side as shown in Fig. 2. The weight of the engine is taken off the frame and jacks placed under the jaws on either side of the weld. Then tram over the break, locating permanent points by which the expansion will be governed. Referring to Fig. 2, the frame should be cut out from both sides to the angle shown, all surfaces being chipped and cleaned preparatory to welding. It is necessary to spread the frame a suitable amount to allow for contraction in cooling, this allowance for contraction varying slightly in amount depending upon the location of the break. Referring to Fig 2, when breaks occur at points

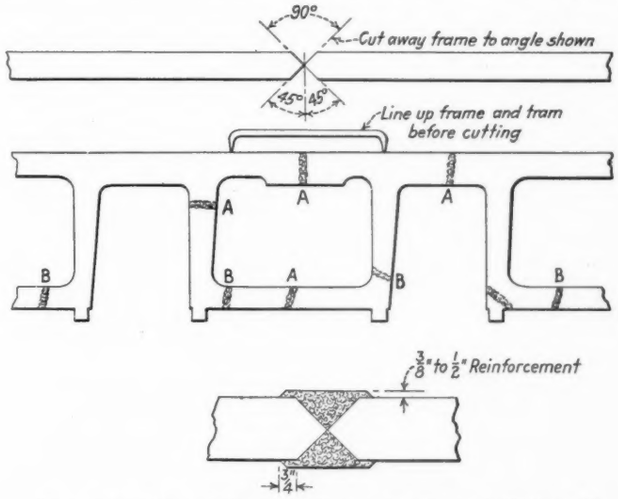


Fig. 2—Location of Common Frame Breaks and Method of Welding with Gas

marked *A*, ¼ in. should be allowed for contraction. At points *B* 3/16 in. is allowed. Whenever welds are to be made in any part of the jaw the binder should be in place if possible. A ⅜ in. plate should be tacked to the lower side of the frame on which a foundation can be made to start the weld. This plate extends out on both sides of the frame the thickness of the reinforcement and is welded firmly to the frame at all points of contact including the edges. This plate forms a base on which to start the weld.

Two operators should be employed, one on each side of

the frame. After the weld reaches the thickness of two inches it should be hammered, this hammering to continue at intervals until the weld is finished. It is important that at no time during the process of the weld any part should be less than red hot. That is to say, the operator should keep the finished part of the weld red hot at all times and when the weld is finished the entire weld should be brought up to an even heat before jacks are removed. This will relieve any internal stress and decrease the possibility of future breaks.

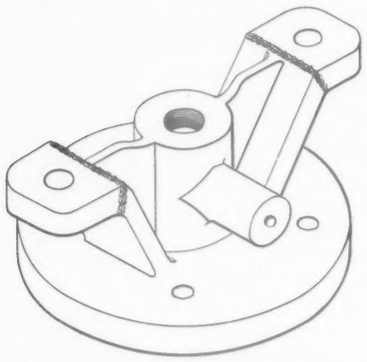


Fig. 3—Air Signal Valve Casting Repaired by Gas Welding

For the amount of reinforcement to be applied reference should be made to Fig. 1 and the accompanying tables.

Miscellaneous Welding and Building Up Jobs

The possible uses of both gas and electric welding in railroad shops are too numerous to mention and both processes

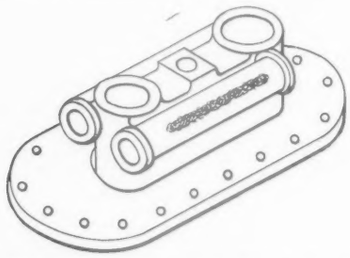


Fig. 4—Air Compressor Steam Head Reclaimed by Gas Welding

have been greatly extended during the past few years, saving large sums of money annually to the railroads. The important point to be remembered, however, is that either welding process costs money and if the locomotive or car part being repaired or reclaimed is small and has a first cost less than the cost of gas or electricity and labor used, it is obviously poor economy to weld it.

For the air signal valve casting, as shown in Fig. 3, how-

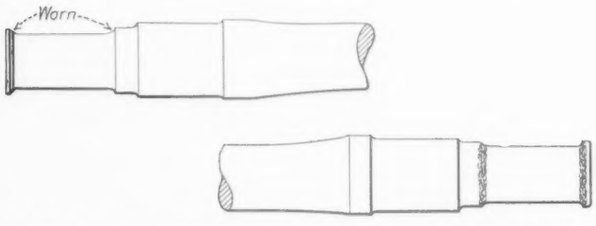


Fig. 5—Building Up Worn Axle Collars; Electric Welding

ever, the cost of labor and gas used in welding on the broken lugs would be considerably less than the cost of a new casting, and it is therefore good economy to make the repair by welding. The castings after being welded by competent operators will be just as good as new.

An interesting example of what can be accomplished with gas welding is shown in Fig. 4. The steam head of the New York air compressor is located at the bottom and, without proper care in draining during the cold weather, will often become cracked through the wall to the exhaust passage as

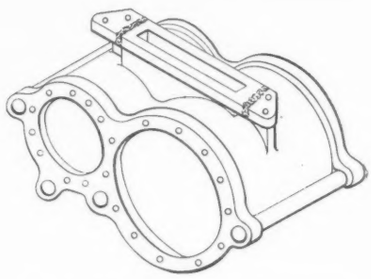


Fig. 6—Air Cylinder Lugs Replaced by Gas Welding

shown in Fig. 4. This steam head is quite an expensive casting with a more or less intricate system of coring in which it was found necessary to maintain walls of equal thickness. The problem in getting a successful weld on this casting is to

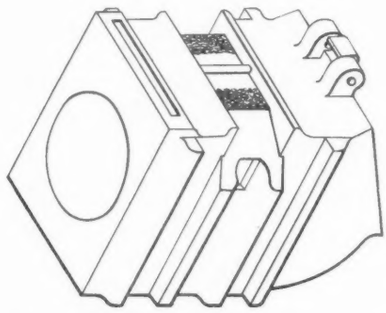


Fig. 7—Building Up Worn Journal Box; Gas Welding Used

provide for contraction and this can be accomplished only by the careful and thorough pre-heating of the steam head after which the crack can be welded with gas. The entire weld and adjoining walls of the casting should be brought to a

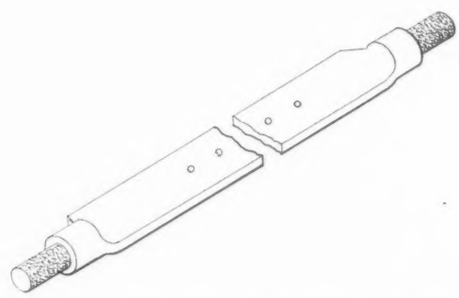


Fig. 8—Building Up Brake Shaft Ends; Electric Welding Preferred

uniform temperature and allowed to cool slowly to prevent internal strain and a subsequent crack which will be worse than the first.

Building Up Worn Parts

Among the possible uses of welding processes perhaps none is more important than the building up of worn parts, in many cases making them as good as new for further use. The example shown in Fig. 5 is a worn axle collar before and after being built up by electric welding. After the weld-

ing has been completed it is necessary to mount the axle in a lathe and remove excess metal deposited on the collar, leaving a smooth fillet of the original dimensions.

Another example of welding broken lugs is given in Fig. 6 in which both lugs have been broken from an air compressor cylinder, either through a wreck or accidental dropping or mishandling on the floor. The common method of repairing a cylinder with broken lugs is to have new lugs forged of wrought iron or axle steel in the forge shop, fitted to the

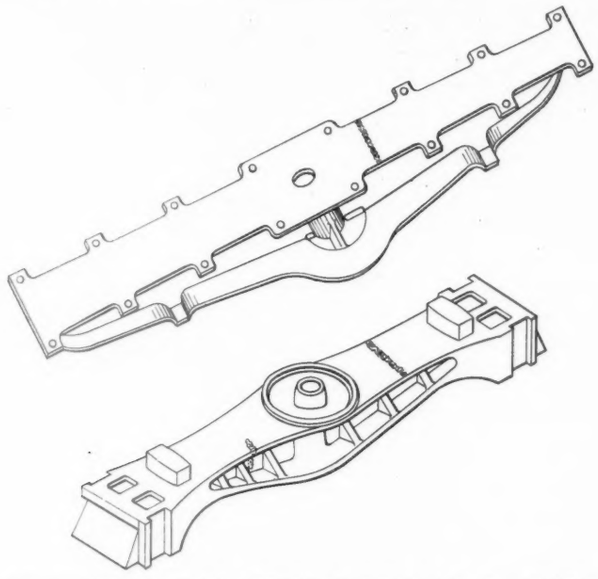


Fig. 9—Steel Car Bolster Effectively Repaired by Gas Welding

cylinder which has been properly machined, and secured in place by three or more bolts through the extended sides of the lug and the cylinder. It is obvious that in both cost and length of time required to make a repair, welding is much to be preferred over the mechanical process of applying new lugs.

The method of building up a worn journal box and the ends of an engine brake beam are illustrated in Figs. 7 and 8 respectively. Both of these parts can be built up and made

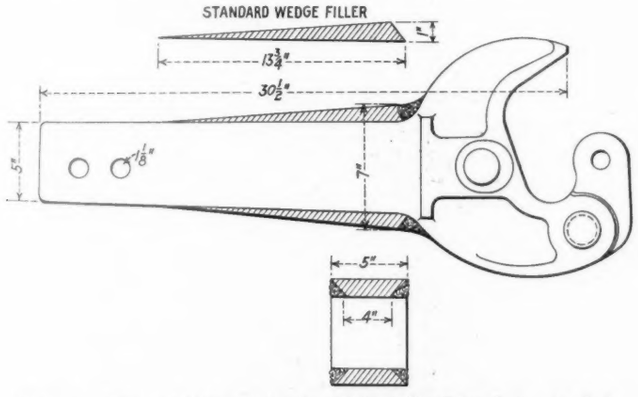


Fig. 10—The Addition of Wedge Fillers Changes 5 In. by 5 In. Coupler Shank to 5 In. by 7 In.; Gas or Electric

as good as new in a very short time and at a slight cost. In the case of the journal box it is advisable to use gas for building up but with the brake beam the electric method would be better. In case gas is used to build up the worn brake beam ends, great care must be exercised not to overheat the ends and the entire beam should be carefully annealed before being machined and put back into service. Otherwise there is a good chance of a train delay due to dropping the brake beam.

The possibilities of welding are also illustrated in Fig. 9 showing heavy steel car bolsters which have become cracked at two points in service and would have to be scrapped were it not for the possible use of the gas welding process in repairing the cracks. As in the case of all complicated castings subjected to tension it is impossible to weld one section and have it cool off without causing internal stress. For this reason due allowance must be made for contraction in cooling and the careful annealing of all parts after welding is necessary to insure a permanent weld.

Another interesting example of welding is shown in Fig. 10 in which a 5 in. by 5 in. coupler shank is changed to a 5 by 7 by the addition of a standard wedge filler held in place by either electric or gas welding as shown in the illustration. One end and both sides of the filler are undercut as shown in the cross sectional view, the undercut space being filled in with welding material, thus holding the wedge filler firmly to the coupler shank. The preceding are but a few of the many interesting examples of welding work performed in modern railroad shops.

What Does the Workman Want?

At the present time there is a great deal of discussion of industrial unrest, and dissatisfaction among the workers is one of the most important problems of shop management. It is seldom that the fundamentals of the problem of overcoming the present situation are so clearly and concisely stated as in the following, which is taken from an address by John Calder, manager industrial relations, Swift & Co., at the convention of the Iowa Manufacturers' Association.

What does the workman want? We know specifically what some people do not wish him to have and what other people insist that he should desire, but let us scrutinize closely what the workman himself really wants. Let us put it very briefly and ask and answer these four questions:

1—What is it?
2—What causes it?
3—What of it?
4—What are we going to do about it?

WHAT IS IT? Just five things:

(a) A Steady job.
(b) Adequate real wages.
(c) A good foreman.
(d) A voice in settling his own conditions.
(e) A chance to rise on his merits.

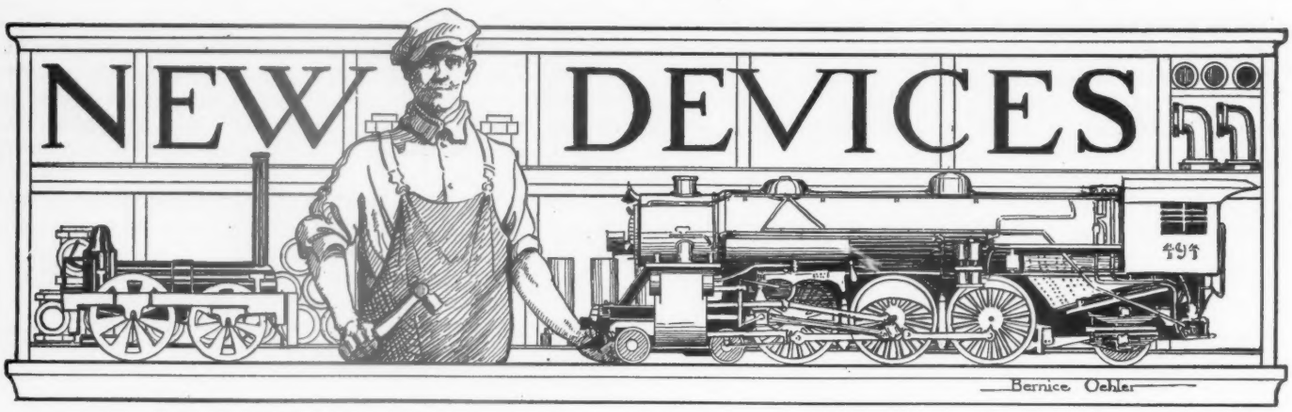
WHAT CAUSES IT? The nightmare of unemployment, the standard of living and the unintelligent and unwise handling of workmen individually and in small groups by supervisors who lack tact and enlightenment and sympathy.

WHAT OF IT? Unrest! Industrial wars and rumors of wars. A state of mind which is fertile soil for the man, often not a workman, who wishes to capitalize the worker's feelings for quite different and subversive purposes.

Men are moved much more by their feelings than by their thoughts. When intelligence, emotions and disposition—the three motive powers of human beings—are appealed to in people lacking necessary information, the fact that your appeal is based on truth has very little to do with the result of those in an exasperated state of mind. What of it? Low production; low morals; little co-operation; readiness to change our social and economic system for others which give no guarantee of betterment.

WHAT ARE WE GOING TO DO ABOUT IT? Educate! Educate whom? The employer, the superintendents and the foremen, the employees and the public in the art of co-operating harmoniously in "getting a living."

Educate how? By suitable literature, talks, personal contacts and open forums of supervisors and employees, where a chance to talk back is afforded and where there is an opportunity to air ignorance and knowledge, truth and untruth.



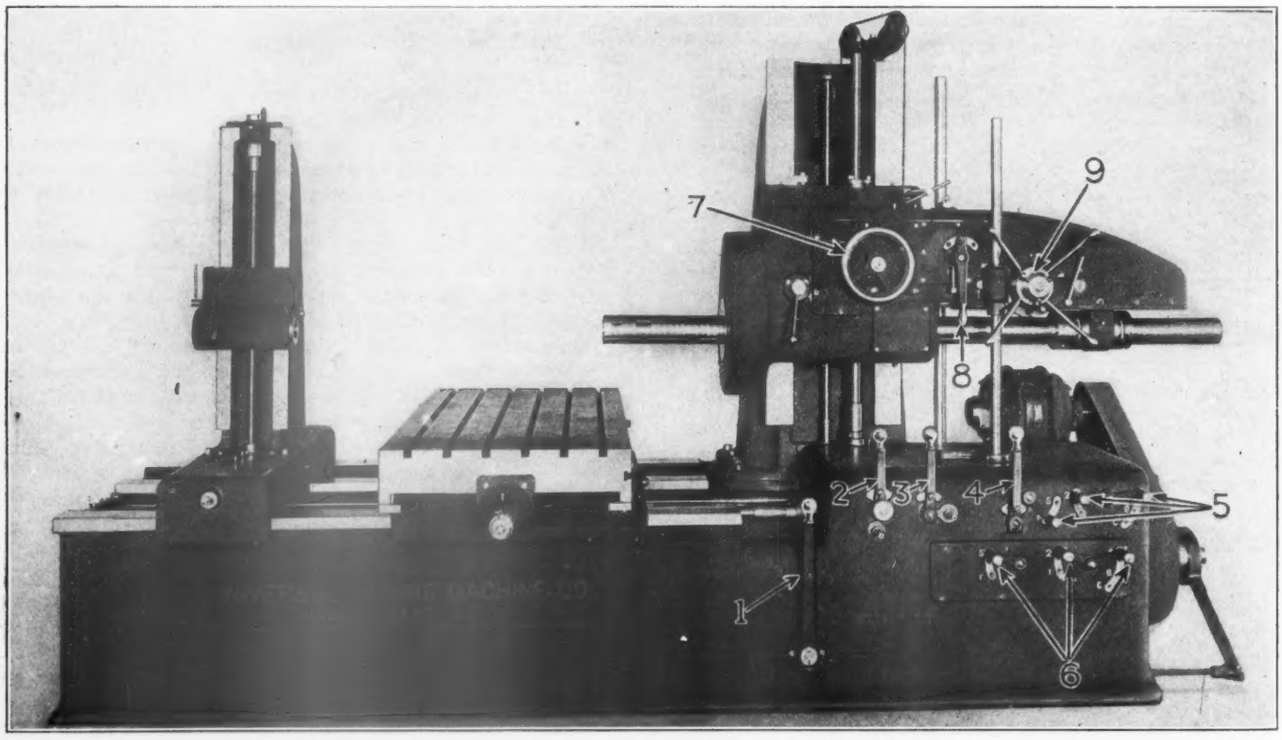
Tri-Way Universal Horizontal Boring Machine

THERE are several distinguishing features about the horizontal boring machine illustrated, which has been developed and placed on the market recently by the Universal Boring Machine Company, Hudson, Mass. One of these features, said to be original, is the use of three flat ways in the front, center and back of the machine to furnish guiding surfaces and support the unusually long carriage. This arrangement practically eliminates table overhang and provides for the boring of holes in the extremities of large, heavy castings. The first boring machine of the three-way, or tri-way, type was completed in 1919 but many improvements in design and construction have since been made and incorporated in the new machine, which is a large size particularly adapted for railroad shop and other heavy work.

The bed of the machine is rectangular in shape, being thoroughly ribbed and braced to prevent springing if it should happen to be placed on a poor foundation. A coolant system is provided and the top of the bed slopes to the head end, allowing the coolant to run down into a settling chamber at the end of the bed. From the settling chamber the coolant overflows into another chamber from which it is pumped through suitable piping to the work. The bed has also been designed to receive an electric motor without the use of an overhanging bracket. Chip chutes from which chips can be removed are provided at the back of the bed.

The rear post is a new and heavier design but requires no special description. Compensating nuts for taking up wear in the elevating screw are shown at the upper end of the screw. The carriage and table are practically the same as in the Nos. 3-A and 3½ Universal boring machines, except for being heavier and designed to take care of the coolant without piping. The head post has been designed in proportion to the rest of the machine with wide bearing surfaces for the head, an arrangement which assures both strength and accuracy.

The head is similar to previous models but is provided with a reversing lever for the boring bar, slow hand feed for the boring bar, and a lever for throwing in the higher boring bar speeds. The speed and feed change gears are arranged in geometrical progression and located in two trays, the lower



Universal Boring Machine Featured by Rugged Construction, Rapid and Convenient Operation and Three Carriage Guiding Ways

tray being filled with oil, and gears in the upper tray being lubricated by slash and oil vapor. Both the speed and feed boxes are operated on the same principle. Levers for shifting speeds and feeds and for operating them are within easy reach of the operator's right hand, all being within a radius of 28 in. Automatic stops and rapid power traverse are provided in all directions. All levers have ball handles and are both easy and comfortable to operate.

Referring to the illustration, lever *1* operates a friction clutch for starting and stopping the main driving shaft. Selective feed lever *2* is provided for throwing in whichever feed the operator desires whether the table cross feed, carriage feed on the bed or vertical feed of the head on the post. When one of the feeds is selected the others are automatically locked out. All feeds and also the rapid traverse for all feeds are thrown in by lever *3*, feeds being reversed by means of lever *4*. Three levers *5* and three levers *6* are provided for changing all feeds and speeds respectively. The handwheel *7* gives fine hand feeds for the boring bar. Lever *8* reverses and sprocket wheel *9* provides rapid hand feed for the boring bar.

The main boring bar of this machine is 4 or 4½ in. in diameter, a No. 6 Morse taper hole being provided in the end. The automatic boring bar travel is 30 in. which may be increased to 60 in. by resetting. The table is 30 in. by 63 in. or 36 in. by 75 in., being provided with power cross feeds of 48 in. or 60 in. respectively. The longitudinal feed of the carriage is dependant on the length of bed and width of table selected. Power vertical feed of 30 in. to the head is provided. The maximum distance from the table to the center of the bar is 30 in. and the greatest distance from the faceplate to the outer support is 72 in., 108 in. or 120 in. Twenty-four spindle speeds are provided ranging from 7 to 285 r.p.m. Twelve feeds in either direction can be obtained, the milling feed varying from ¼ to 5⅝ in. per min. and the boring feeds from 1 in. to 2 13/16 in. per min. An 18-in. by 4-in. driving pulley is required on the friction clutch, the pulley to operate at a speed of 230 r.p.m. The floor space occupied by the machine is 45¼ in. by 145¾ in., its shipping weight crated being about 2,200 lb.

One 3-in. plain extension boring bar 50 in. long with a No. 6 Morse taper hole at one end is provided as regular equipment; also four drill sleeves with necessary cranks and wrenches. Special sizes of beds and tables including a 30 or 36-in. rotary table, also an auxiliary table 72 in. long by 8 in. wide with one T-slot, can be provided. Motor equipment with motor base, sprockets and chain also are furnished to order as special equipment. The machine is constructed with a junction overload clutch on all feeds. This is adjusted to take the maximum cut of the machine. Beyond that point it will give, thus safeguarding against any accidental breaking of the parts of the machine.

Dual Flow Steam-Driven Air Compressor

THE steam end of the Dual Flow steam driven air compressor recently developed by the Chicago Pneumatic Tool Company, New York City, is said to be entirely new and distinctive, yet based upon principles which have already proven their soundness and superiority in steam engine practice. The foremost feature of this machine, illustrated in Fig. 1, is the steam cylinder which is so designed and constructed that initial condensation is almost entirely eliminated, resulting in a great saving in steam power.

Initial condensation is one of the greatest preventable

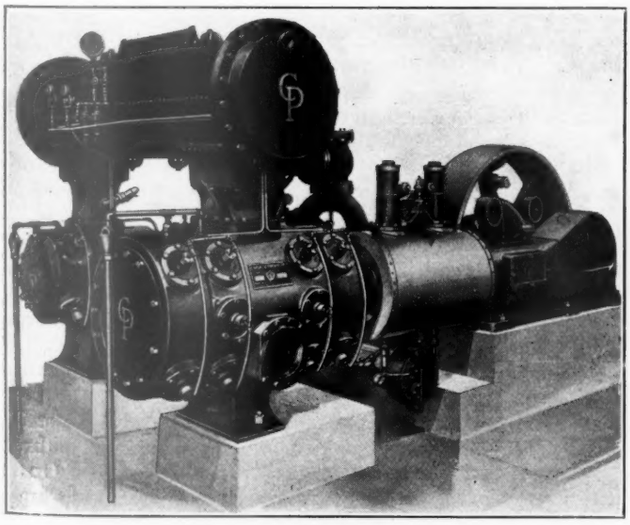


Fig. 1—General View of Dual Flow Air Compressor

losses in steam engines of the old counterflow or compound type; it is caused by the cooling of the cylinder walls and head by the comparatively cool exhaust steam as it washes over them in leaving the cylinder through the same port by which it entered. In the Dual Flow cylinder, the exhaust steam does not wash back over the cylinder walls and head, but leaves through a port in the center of the cylinder. Thus the interior surfaces of the cylinder walls and head remain at very nearly the same temperature as the entering steam and initial condensation is reduced to the absolute minimum.

The exhaust port is uncovered by the piston when the latter has traveled about half its stroke. The exhaust is controlled, however, by a patented, steam-tight poppet valve, which opens when the piston is near the end of its stroke and closes again (if the machine is running non-condensing) when the piston covers the port on the return stroke. When running condensing, the valve closes early in the return stroke.

The Dual Flow cylinder was designed to have several advantages over unaflow types. In the first place, a material saving in steam consumption when running non-condensing is claimed. Since the piston of a unaflow engine covers the

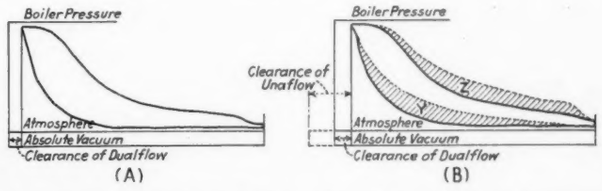


Fig. 2—Comparison of Unaflow and Dual Flow Indicator Diagrams

exhaust port at the start of the return stroke, some provision must be made for preventing excessive compression. This usually takes the form of large clearance spaces. If there is any back pressure, there must be still greater clearance. Compression in the Dual Flow cylinder on the other hand does not begin until the piston has traveled half the return stroke. The result can be plainly seen by referring to Fig. 2 *B*, in which the diagram *A* of a Dual Flow cylinder is superimposed upon that of a large clearance unaflow machine.

First, the area *A* is lost by the unaflow machine, owing to early compression. It must be offset by the area *Z* which means the addition of more steam, later cut-off, higher release and less expansion.

Second, the Dual Flow design permits of a shorter cylinder

and much shorter piston, hence the weight of the reciprocating parts is considerably less.

Third, there is less friction and the cylinder can be more easily lubricated.

A section of the cylinder, showing its construction, is given in Fig. 3. Valve leakage probably causes a greater steam loss than any other single factor. Especially is this true of installations where superheated, high-pressure steam is used; in fact, the faults common in most of the valves now used, such as leakage, excessive clearance, necessity of valve lubrication, etc., have partly offset the advantage to be derived from the use of superheated steam. Too much attention, therefore, cannot be given to the type of valve used.

A solution of the valve problem has been sought in the case of the Dual Flow steam driven air compressor by the adoption of the Skinner steam-tight, double-seat poppet valve for both admission and exhaust. This valve is said to remain steam tight indefinitely and seat perfectly, regardless of the pressure or temperature under which the cylinder is operated. It has been known to keep steam tight, with one grinding, with 159 lb. pressure and 150 deg. F. superheat and also with saturated steam at 100 lb. pressure. No lubrication is required.

Inequalities of expansion of the metals forming the valve and seat due to different co-efficients of expansion, are compensated for and no side thrust is imposed upon the stem by the lifting mechanism.

The governor is mounted in the flywheel and operated by centrifugal force and inertia. The governor arm is connected to the steam valve eccentric and by changing the throw of the latter it changes the point of the cut-off of the steam entering the cylinder. This method is obviously superior to the old scheme of merely throttling the steam. It is apparent that variations in speed may be made by adding or removing weights.

Unlike the old counterflow engines, which were regulated economically by slowing down during the unloaded periods of the compressor, the Dual Flow is a constant speed machine and shows the best steam economy when operating at its greatest speed. Regulation is therefore effected by two-step capacity control. Two differential unloaders connect with the inlet valves and reduce the capacity of the compressor in two steps. One unloader holds open the inlet valves on the crank end of one cylinder and the head end of the other. The second unloader holds open the inlet valves at the opposite ends. This is one of the simplest, most positive and most efficient methods of regulation known. The air valves are of the Simplate, independent disc type.

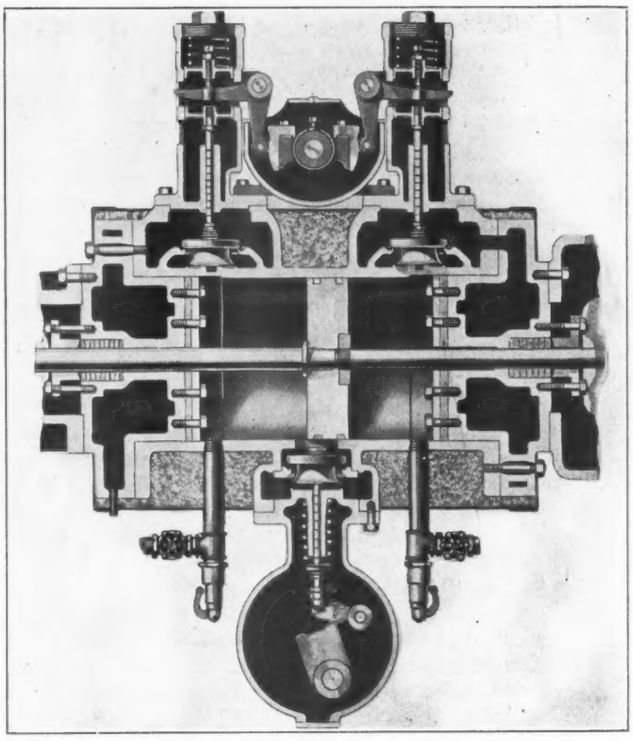
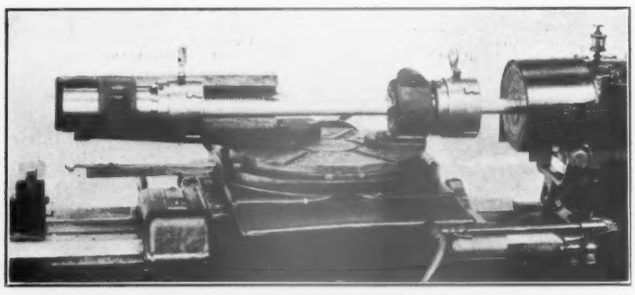


Fig. 3—Cross Section of Dual Flow Steam Cylinder

Staybolt Equipment for Flat Turret Lathes

THE advantages of the staybolt equipment developed recently by the Acme Machine Tool Company, Cincinnati, Ohio, for use on flat turret lathes are readily apparent, the principal object of this equipment being to produce accurate threads of the same concentricity and lead on both ends of staybolts. It is essential to have both die heads cutting simultaneously so that the leads will correspond exactly with that of the master stay bolt tap. The rear die-head is made adjustable, as shown in the illustration, so that any length of bolt within the range of the machine can be handled.



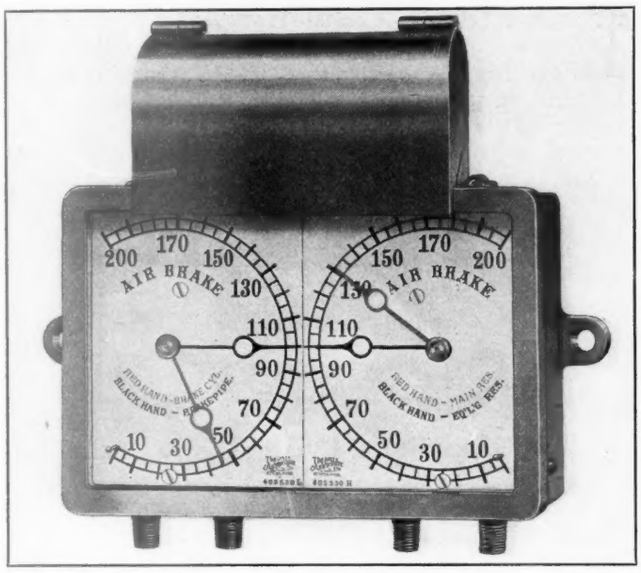
Staybolt Thread Cutting Equipment for Use on Cincinnati Acme Flat Turret Lathes

In operation the staybolt is first turned complete with a multiple cutter box tool provided with an adjustable tool for recessing the blank space between threaded ends. (This box tool is not shown in the illustration which gives a rear view of the thread cutting equipment.) After the staybolt has been turned the die heads are brought into position as shown. The front tool holder carries one die head while a special adjustable holder carries the rear die head. A micrometer collar is provided on the screw for accurate adjustment so that both die heads have the same relative lead.

Regular staybolt equipment can be provided for the 2½ in. by 26 in. Cincinnati Acme flat turret lathe to thread staybolts 1¼ in. in diameter by 14 to 24 in. long. On the Universal or 3¼ in. by 36 in. flat turret lathe, bolts up to 1½ in. in diameter can be threaded and lengths from 14 to 25 in. long. With special turners, work from 8 in. to 14 in. long can be accommodated in one chucking. Work less than 8 in. long can be threaded before releasing. A special slide arrangement can be provided on the 3¼ by 36 in. and the No. 3 universal flat turret lathes to thread the following lengths: No. 3 Universal, 25 in. to 42 in.; 3¼ in. by 36 in. flat turret lathe, 25 to 34 in., with diameters as mentioned above.

Quadruplex Locomotive Air Brake Gages

THE Ashton Valve Company, Boston, Mass., has made an innovation in gage design in the combination of two duplex air gages in one body as illustrated. These gages, known as quadruplex gages, are made in the 3½ or 5-in. sizes ordinarily used on locomotives and can be provided with or without the electric light attachment shown in the upper part of the illustration. The advantages of the new construction include uniformity of dial size, economy of space, centralized location of both gages with indicating hands near together and fixed location of the zero readings. Consequently the engineer, by concentrating his vision particularly on the brake pipe and equalizing reservoir pressure hands may regulate more uniformly and accurately brake application and thus secure smooth handling of the train.



Ashton Five-In. Dial Quadruplex Locomotive Air Brake Gage

The illumination of the dials is accomplished by the special enclosed electric light attachment, which prevents diffusion of the light rays over other sections of the cab and thus in no way interferes with the engineman's vision. The electric attachment is designed for a standard cab lamp, 16 watts, 34 volts, having standard receptacles with lamp grips as adopted by the A. R. A., Mechanical Section, in 1920. Gage dials are graduated to 150 or 200 lb. as specified, but are marked as illustrated unless otherwise ordered.

The gage case, being oblong, will facilitate installation in a vertical position and establish a uniform location of zero marks, a condition which is more or less difficult to determine with round case gages. No difficulty will be found in connecting the original copper gage pipes to the fittings on the new gage.

The movements and interior construction of the gages are similar to those used on the Ashton Duplex air brake gages and involve no complications in repairs. The quadruplex air gages are so constructed that one gage may be tested, adjusted or repaired without interfering with the others. The 5-in. gage, without electric light attachment, is called No. 62-Q and with the attachment No. 62-Q-E.

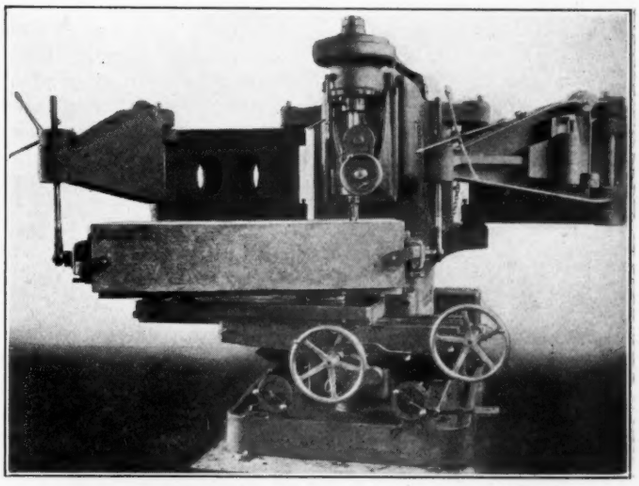
Die Sinking Machine for Work on Large Dies

A DIE SINKING machine incorporating unique features, particularly adapting it to handle large dies, has been placed on the market by the Pratt & Whitney Company, Hartford, Conn. By means of Bayrer's compensating arms, a die weighing four tons may be suspended by elevating screws, placed in position on the table and easily swiveled, tilted or turned on edge by the operator. The hand feeds are thereby rendered sensitive to light cuts and the die may be fed over to extreme limits for cutting gates without the slightest cramp.

The compensating arms can be folded back and latched against the sides of the column. Hinge shafts for the arms are attached to the column with pins through massive ears. The arms are carried on roller bearings supplemented by ball bearings. They are, therefore, sensitive to any movement imposed on the die.

Fig. 1 shows a front view of the machine with the arms extended supporting a die which is swiveled on the table and moved into position for a cut near the end of the die. Both of the outer carrying arms are provided with balance beams and adjustable weights by which the load of the die can be approximately balanced and relieved from the table. Crabs attached to the end of the die provide trunnions by which the die is supported and on these trunnions it may be readily tipped on its side for edge cuts. When the die is being tipped on its side the table is dropped clear of the die, the arms sustaining the entire load.

The machine is of the knee type, permitting proper elevation of dies of various thicknesses to bring the cut to a convenient level for the operator. To this end the range of the knee travel is kept exceptionally low down and platforms are unnecessary. The cutter spindle is mounted in a counterweighted vertical head provided with hand feed with a graduated dial. A rapid traverse for the quick adjustment of the head is provided. Power to the cutter spindle is transmitted through a quarter turn belt from the gear box in the rear of the machine. All changes of speeds and feeds are made by levers in front of the machine convenient for the operator.



Pratt & Whitney Die Sinking Machine

Hand and power feeds are furnished for both the longitudinal and cross feeds of the table. In addition a rapid power traverse is provided for all movements of the table, including elevating and depressing. The mechanism driving the power movements operates through a friction to prevent injury to parts in case of over-running. A cherrying

attachment is readily applied to the cutter head, drive being effected through gearing to the nose of the cutter spindle. When not in use the cherrying attachment is swung back out of the way and does not interfere with the use of the machine. The machine is equipped for either a constant speed drive direct from a line shaft or from a motor mounted on the machine. It is also made with and without the die-carrying arms.

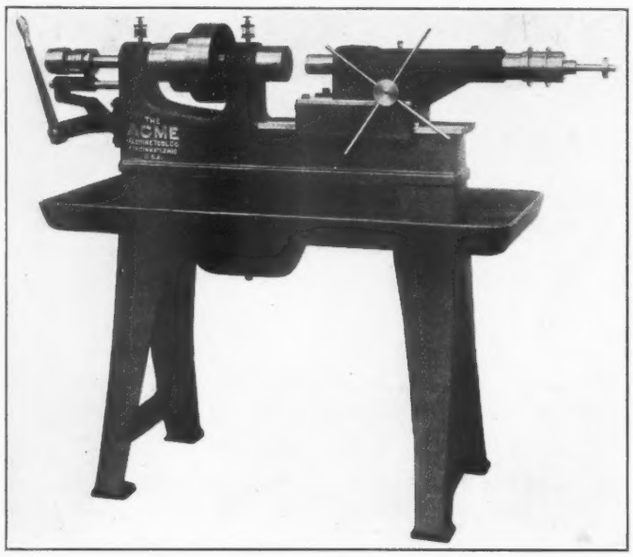
The table top dimensions are 22 in. by 48 in.; the table longitudinal feed, 48 in.; table cross feed, 17 in.; table vertical feed, 15 in.; cutter head vertical feed, 12 in.; spindle speeds (12), varying from 27 to 79 r.p.m.; table power feeds (9), from 9/16 in. to 10 in. per min.; table rapid traverse, 42 in. per min.; floor space parallel to table, 10 ft.; height of machine, 9 ft and weight, approximately 16,000 lb.

Horizontal High Speed Drilling Machine

ESPECIALLY adapted to the drilling of small, deep holes, a horizontal high speed drilling machine has been developed recently by the Acme Machine Tool Company, Cincinnati, Ohio, and added to this company's line of turret machinery. The design of the machine generally is similar to that of a hand-screw machine in that the spindle and chuck operations are identical. The work is held in the automatic chuck, which is opened and closed by means of the chuck lever, located at the front head end of the bed.

The high speed drill spindle which takes the place of the standard turret is provided with a No. 1 Morse taper at the front end for holding the drill chuck. This drill spindle is driven from a pulley on the countershaft and connected by a belt to a flanged pulley on the spindle. Both spindle and pulley are provided with ball bearings, the bearings for the pulley being mounted on a separate stationary sleeve, through which the drill spindle passes. This relieves the drill spindle proper from all belt pull and allows it to be operated easily and quickly. The spindle is mounted in a seperate sleeve provided with racks into which meshes the gear on the turnstile shaft. The turnstile handle moves this spindle backward and forward and the stop collar on the end of the spindle acts as a stop gage when the drill has reached the depth desired.

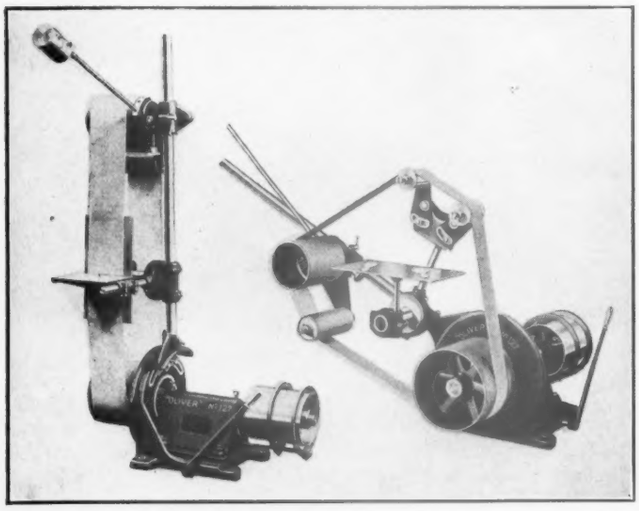
The spindle is mounted in a casting block which in turn is mounted on the turret slide saddle, and this arrangement permits locating for long or short pieces, as may be desired. The drill spindle is ordinarily run at approximately 3,000 r.p.m. and this speed, together with the machine spindle speed of 500 gives a combined drilling speed of 3,500 r.p.m.



Acme Horizontal High Speed Drilling Machine

Variety Belt Sanding and Polishing Machine

A VARIETY belt sander has been developed by the Oliver Machinery Company, Grand Rapids, Mich., designed for the rapid sanding and polishing of all kinds of small irregular shapes, edge work and flat surfaces; also for polishing metal surfaces. It can be used in wood working and pattern shops, or wherever a finishing and polishing machine is required. Features which are claimed for the machine include rapid production, ease of setting up work and maximum convenience and safety to the operator in performing his duties.



Variety Belt Sanding Machine for Rapid Sanding and Polishing

The main drive pulley is mounted on a countershaft, located on a substantial base, with a frame swinging about the center line of the countershaft and carrying a support arm. On this support arm are carried two clamp brackets, one of which supports the main idler pulley and the tension idler. The other supports the table and backing plate or any forms or flexible pads desired.

The machine will take belts up to 10 in. wide and 14 ft. long. The 10 in. by 12 in. edging table tilts to any angle up or down to 30 deg., can be adjusted in or out, and has drilled holes for attaching wood tops or forms. The backing plate is 10 in. wide and can be adjusted in and out to suitable tension on the belt; it has drilled holes for attaching flexible pads.

The main idler runs in ball bearings and is adjustable up or down the whole length of the idler arm to take care of various lengths of belts. The tension idler is of the ball bearing type, fulcrums in the center line of the main idler and is balanced by weights to give the right tension to the belt. Both the main and tension idler pulleys are faced with leather.

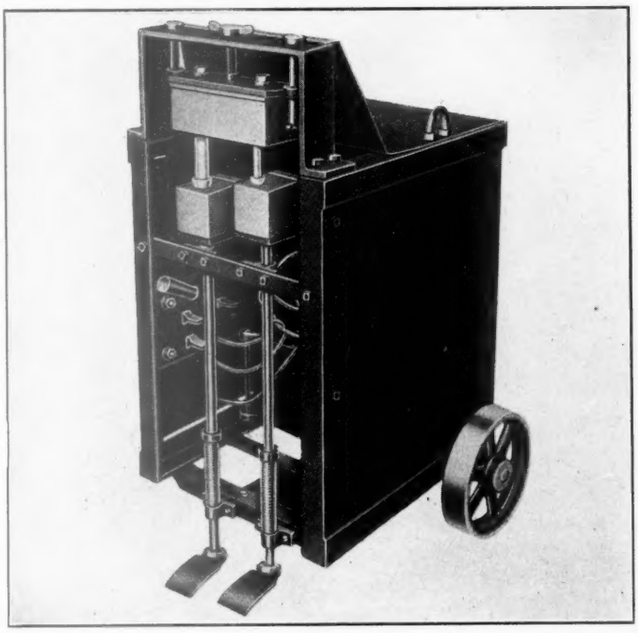
The fork idler of this attachment, mounted on the machine

in place of the regular table, is used for doing oval sanding, such as oval frames and all irregular shapes. The fork idler, rigid in construction, carries two aluminum idlers which run in ball bearings and are adjustable to the work.

The height of the machine is 80 in. over all and about 4 by 8 ft. of floor space is required. A 2-h.p. motor, running at about 900 r.p.m. is required when direct connected to the lower drive pulley.

Portable Electric Rivet Heating Devices

THE increased popularity of rivet heating devices using electrical energy is everywhere in evidence and based on several important advantages. In convenience of operation, cleanliness and ready movement from place to place, the electric rivet heater surpasses any other type made.



United States Electric Rivet Heater Heats Rivets from ⅜ In. to 1½ In. in Diameter in Lengths up to 6 In. without Adjustment

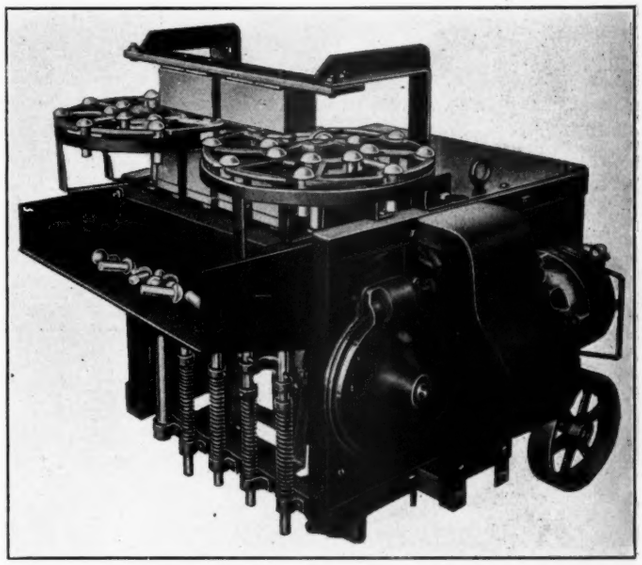
Hot rivets are provided in a few seconds and being heated from the inside, rivets are free of scale, have a uniform temperature throughout and there is a minimum number of lost and burnt rivets. On account of the fact that current is used only when rivets are being heated, the machines lose little heat by radiation and are comfortable to work around.

The rivet heater, illustrated in Fig. 1, was designed recently by the United States Electric Company, New London, Conn., and embodies the advantages mentioned above. It was built to meet the requirements of structural steel builders, boilermakers, car manufacturers and in fact any one who uses hot rivets from ¼ in. to 1½ in. in diameter by 6 in. long. The time for heating a rivet of the largest size is about 30 seconds.

The device is built in three types A, B and C with electrodes arranged to heat two, four or six rivets at one time. The large type C machine can heat twelve pin rivets per minute, which is as fast as they will ordinarily be required. Ten, 15 and 20 kw., respectively, is the power consumption of the machines, depending upon the diameter of rivets to be heated.

A pan is supplied with the heater when it is desired to hold a quantity of rivets in front of the operator or heater, and the rivets are easily placed by hand in the electrodes and removed with the tongs when heated. The operation is simple. The control switch being set for the size of rivets to be heated, the operator presses down on the foot lever and places a rivet between the electrodes until the desired heat is obtained. By heating in series after the first two rivets are heated, there is always a hot rivet ready for the riveter, and the operator always can control the current by removing one rivet, eliminating the pulling of a switch. The switch will be supplied if specified so that it will not be necessary to remove the rivet. The machine operates on 60 cycles and 220, 440 or 550 volts, single phase.

The automatic rivet heater, illustrated in Fig. 2, is built to heat rivets when making long runs on one size of rivet, heating as high as 12-¾ in. by 2½ in. rivets per minute. The machine is equipped with a control switch, the disks being arranged to hold any size rivet and accommodating 32 at one loading. The electrodes can be adjusted for any length of rivet up to five inches long and timed to give the desired heat in the rivet.



Automatic Electric Rivet Heater for Use When Making Long Runs on One Size of Rivet

New Mezzo Steel Developed for Drills

A STEEL of moderate cost and between carbon and high speed steel in cutting ability has been produced recently by the Cleveland Twist Drill Company, Cleveland, Ohio, and called Mezzo steel. This new steel is said to possess unusual qualities as the result of introducing a certain combination of alloys and giving a special heat treatment. It is well understood that a large number of shops are not equipped with sufficiently modern, powerful machines to get maximum results from high speed drills. They are forced to reduce the speed of the drills, and if rigidity is lacking, also the feed, this reduction resulting in much less work per hour. For maximum efficiency and strength, high speed drills must be run fast enough to keep them fairly hot, and if the equipment will not allow this, a reduced speed nearly always re-

sults in breakage, which is costly. Costly breakage forces many shops with improper equipment to go back to carbon steel tools and this results in a greatly reduced productive capacity.

It is evident that a great saving in expense can be made and maximum production obtained in the above cases by the use of a drill which sells at a moderate price and which will stand up under speeds and feeds considerably above those possible with carbon drills. Mezzo drills are recommended for drilling cast iron at greater speeds and feeds than can be used for carbon drills. In drilling machine steels and the softer alloy steels, Mezzo drills are said to be excellent, performing at much higher rates of speed and feed than those made of carbon steel. They are not, however, recommended for use in extremely hard materials. For this purpose high speed drills still outclass anything developed and their comparatively high initial cost is more than offset by the greater production.

The accompanying table of data from Mezzo drill tests is said to represent good general practice and should be compared with an average peripheral speed for carbon drills of about 35 ft. per min. in cast iron or machinery steel, with .010 in. feed per rev. It will be seen that the new drills produced holes at over three or four times the normal rate of carbon drills. Mezzo drills are furnished in sizes from 9/16 in. to 2 in. inclusive and are carried in stock for prompt deliveries in any standard size.

Table of Comparative Drill Tests

Size Drill	Material	R.P.M.	Feed Per Rev.	Peripheral Speed, Ft. Per Min.	Inches Drilled	
					Mezzo	Carbon
5/8	3 in. C. I.	356	.031 in.	60	60*	5
5/8	4 in. M. S.	356	.024 in.	60	32*	½
¾	4 in. M. S.	294	.024 in.	58	10½	¼
¾	4 in. M. S.	225	.020 in.	50	32¼	½
¾	3 in. C. I.	294	.020 in.	58	30*	1
15/16	4 in. M. S.	225	.024 in.	55	8	½
15/16	3 in. C. I.	294	.032 in.	75	30*	2½
1	4 in. M. S.	225	.015 in.	60	21	1½
1	3 in. C. I.	225	.020 in.	60	25	1
1¼	4 in. M. S.	180	.016 in.	59	24	4
1⅜	4 in. M. S.	144	.020 in.	51	12	1½
1⅝	4 in. M. S.	144	.032 in.	61	30*	2¾
2	4 in. M. S.	106	.015 in.	55	32*	3¼

Note—3 in. C. I. means a cast iron billet 3 in. thick.
4 in. M. S. means a machinery steel billet 4 in. thick.
*means test stopped, drill still in good condition.

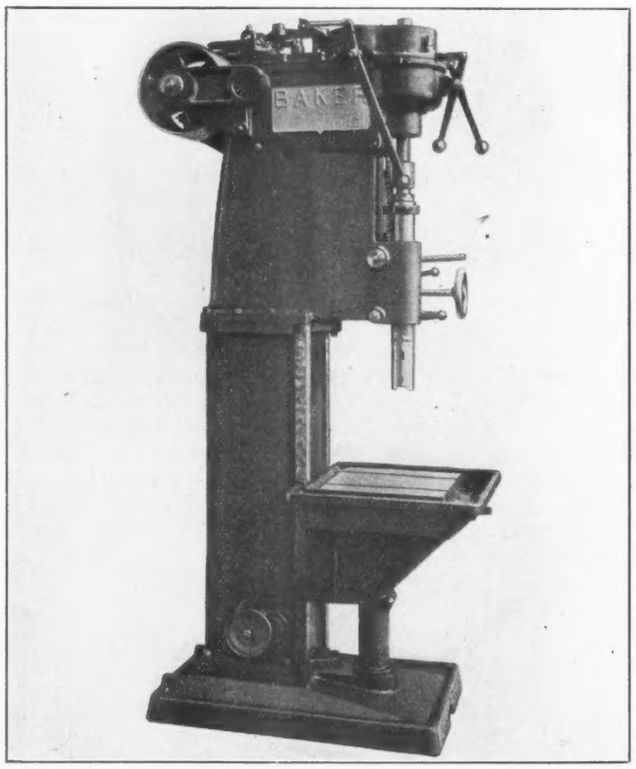
Single Purpose and Quick Change Drill

THE drill, shown in the illustration, is a single purpose machine intended for medium duty boring and drilling work and arranged to be provided with a quick change speed box if desired at small expense. As a single purpose machine, speed changes are made by transposing gears, but should the customer desire a quick change of speed, a speed box can be installed giving four changes with one set of slip gears in the same position. This arrangement provides practically an unlimited number of combinations. The feed train is handled in the same manner, both single purpose and quick change.

Another innovation is the mounting of the tight and loose pulleys at the back of the frame, the shaft being supported by lugs cast upon the machine itself. This not only insures greater rigidity but also gives the opportunity of placing these machines in gangs at unusually close center distances, which is desirable where the work is of such a nature that one operator can handle two, three or possibly four spindles at one time. This machine is made by the Baker Bros., Toledo, Ohio, and is designed to handle drilling operations from ⅜ in. up to 1½ in. maximum diameter. It has a proportionate capacity for boring and facing operations and yet is easily and quickly handled as a light sensitive drill. When used as a single purpose machine it is fitted with exactly the proper speeds and feeds, there being no unnecessary gears and shafts running idle and wearing as well as lowering the efficiency of the machine.

The distance from the center of the spindle to the column face is 11 in. and from the end of the spindle to the table is 29 in. The length of feed is 12 in.; vertical adjustment of table, 18 in. The table when furnished plain is 15 in. by 16 in. When fitted up as a single purpose machine, speeds of 144, 226, 300 and 468 r.p.m. are provided. When fitted up as a quick change machine, 16 speed changes from 39 to 632 r. p. m. are available. The feeds on the single purpose machine are .008 and .025 in. per revolution. The feeds on the quick change machine are 10 in number, varying from .008 to .094 in. per revolution. The pulley speed is 600 r.p.m. The standard speeds and feeds listed above are comprehensive and cover the average requirements, but if other combinations are desired they can be furnished.

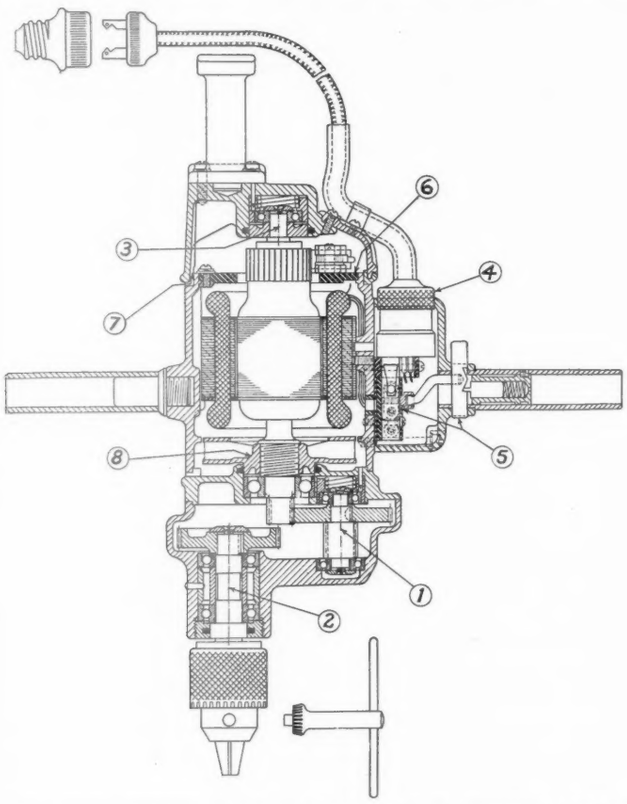
This machine may be arranged for driving with an individual motor when desired. For this arrangement the machine is furnished with the base extended in the rear to which the motor is bolted. This makes the machine and its motor self-contained, which is especially desirable if it is at any time necessary to move the machine. Motor speeds should preferably be 1,200 r.p.m. though it may run at any speed. A tapping reverse, supporting bracket for heavy boring operations, positive depth feed, or multiple depth stop can be furnished as special equipment.



Baker No. 121 Medium Duty Drilling and Boring Machine

Rugged Portable Universal Motor Drill

PERHAPS the most important feature of the portable electric drill, illustrated, which was recently placed on the market by the Hisey-Wolf Machine Company, Cincinnati, Ohio, is its rugged design throughout. This new drill is known as the Super-universal motor drill, being built in ⅜ in. and ½ in. sizes. Approved construction features are included, and the motor, also made by the Hisey-Wolf Machine Company, is of modern design, provided with ball bearings throughout.



Hisey-Wolf Portable Electric Motor Drill of Improved Design

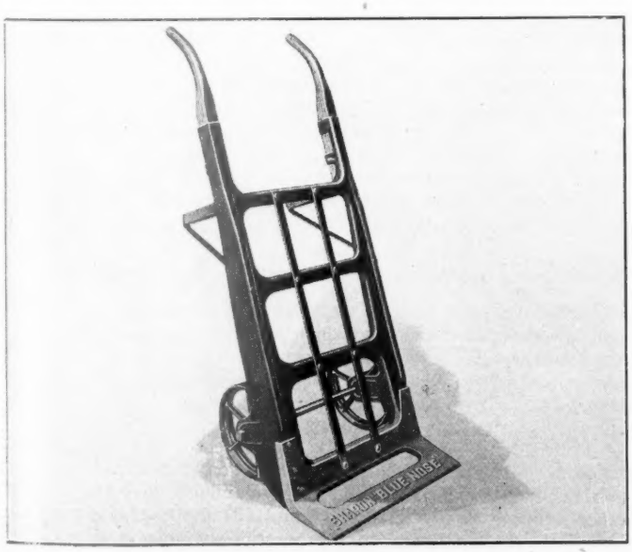
Referring to the illustration, all revolving spindles, *1*, *2* and *3*, are fitted with ball bearings securely fastened, thereby eliminating slipping. To eliminate all strains common with permanently fixed bearings spring tension is provided, a feature which automatically permits expansion and contraction of the shafts without distortion. In addition, free and uniform traction of the balls tends to add greatly to the life of all parts.

The quick cable connector *4* is an important feature. This external connector permits cable repairs and renewals to be made without dismantling the machine, thereby preventing much inconvenience and loss of time. The patented switch *5* is furnished as standard equipment and while externally mounted, is protected with a removable switch handle cover. The brush holder yoke *6* is made of bakelite, which is not affected by oil, moisture or atmospheric conditions and therefore will not warp or change in form. The complete yoke is adjustable and the motor brushes can be adjusted from outside without dismantling the machine. Forced ventilation is applied scientifically. The vent openings *7* at the handle end of the machine are so designed that all the cool incoming air must pass over the commutator and brushes before being drawn through the motor and expelled. The design and mounting of fan *8* prevents the lubricating grease in the gear head from working into the motor parts.

It is claimed for the new machine that its mechanical parts are so proportioned as to meet the most severe service requirements and that the drill has an unusually low operating cost (current consumption) compared to drilling capacity.

Hand Truck Designed for Heavy Service

A HEAVY service hand truck, shown in the illustration, has been developed by the Sharon Pressed Steel Company, Sharon, Pa. It is featured by large, easy-running wheels and rugged construction, being designed to withstand the rough usage usually given this form of truck in actual service. The truck is known as the Bluenose, a name taken from the distinctive steel blue color of the nose. The truck frame is made of a single piece of ⅛ in. hot-rolled, open hearth steel, pressed into the shape shown and provided with reinforcing beads and flanges at points subject to extra heavy stress. The wheel lugs, an integral part of the frame, are stiffened by one-half inch beading pressed in place.



Sharon Hand Truck Made With One-piece Pressed Steel Frame

The nose of the truck is pressed from ¼ in. steel with heavy flanges at the corners to prevent springing when lifting a load. The footings are of pressed steel, sufficiently heavy and well braced to withstand double the rated load of the truck. It will be noted from the illustration that the wheels are housed within the frame, so that the axle is supported in lugs at four points instead of two as is the usual construction. The Bluenose truck is furnished with malleable iron wheels with either plain or roller bearings, or with cushion wheels of approved type. Handles for the truck are of oak, steamed and bent, being held by lag screws and easily replaced should one become broken accidentally. Straight handles can be provided if desired, the nose of the truck may be made square or round, crossbars straight or depressed, or handles long or short. The Bluenose is made in two sizes, 54 in. long by 18½ in. at the nose, weighing 65 lb.; and 64 in. long by 23½ in. at the nose, weighing 120 lb.

GENERAL NEWS

Six electric locomotives left for foreign markets during October. Five of these valued at $228,345, went to Brazil for the new electrification equipment being installed there; one, invoiced at $8,500, went to British South Africa.—Bureau of Foreign and Domestic Commerce.

The Arcola hot water apparatus is to be used to heat the 23 passenger cars of the Piedmont & Northern, an electric road 127 miles long, in North Carolina and South Carolina. Anthracite coal will be used. Hitherto the cars of this line have been heated by electricity.

The Interstate Commerce Commission has issued its ninth quarterly summary of accident investigations made by the Bureau of Safety, covering the reports completed in the three months ending with September, 1921. This pamphlet, 32 pages, covers 17 accidents—seven collisions and 10 derailments.

According to the annual railway accident reports of roads in Great Britain during the 20 years, 1901 to 1920 inclusive, 99 cases of bursting of boilers or tubes of locomotives occurred in that period, resulting in seven railway employees being killed and 111 injured. According to The Engineer from which these figures are taken, the reports do not distinguish between explosions of boilers and explosions of tubes but as in all but six cases employees were injured, the consequences were apparently serious on each occasion.

Serbia to Receive German Locomotives

The kingdom of the Serbs, Croats and Slovenes will receive on account of reparation 50 locomotives and 2,500 freight cars from Germany.

Stinnes a Locomotive Builder

It is reported that the factories purchased by Hugo Stinnes in Rumania have begun the construction of 2,000 locomotives for the Russian Soviet Government.

Austrian Cars Allotted to Italy

The conference of the states of the former Austro-Hungarian Monarchy at Cortorose has decided that 2,000 Austrian cars are to be transferred to the Italian State Railway Administration.

Rumania to Build Rolling Stock

The Societe Franco-Roumaine du Materiel du Chemin de Fer has been formed in Bucharest for the construction of railway rolling stock. On the other hand, the Rumanian State Railway Administration has ordered 150 locomotives and 1,500 freight cars from Germany.

Surplus Serviceable Cars

According to the weekly reports of the Car Service Division of the American Railway Association, there were large increases in the freight car surplus during the weeks ended November 15, 23, 30 and December 8. During these periods the totals were 140,189, 213,523, 282,962 and 368,042, respectively.

Bad Order Cars

The reports of the Car Service Division of the American Railway Association showed 333,616 freight cars in need of repairs on November 15, or 14.4 per cent of the cars on line, as compared with 345,801, or 15 per cent on November 1. This represents a reduction of 11,585 cars. A decrease was also noted for the period ended December 1, the total reported being 320,292 cars, or 14 per cent.

Swedish Turbine Locomotive

Advices from Stockholm state that the Ljungstroems Steam Turbine Company's turbo-condenser locomotive was successfully tested on October 22. A speed of 90 kilometers (56 miles) per hour was attained, a heavy train being pulled. The new locomotive is said to effect a saving of 50 per cent in fuel as compared with the ordinary steam locomotive.

C. M. & St. P. Officers Fined

H. E. Byram, president of the Chicago, Milwaukee & St. Paul and three other officers were fined one hundred dollars on November 8 on each of 25 charges brought by employes who claimed that their wages were docked when they left work in order to vote. The officers were granted sixty days to file a bill of exception and make an appeal. The execution of the fine will be postponed pending the outcome of the appeal.

Electrification of Hungarian State Railways

The Hungarian State Railway Administration has decided to electrify 870 miles of line. The plans for the electrification call for completion in about four years. By electrifying these lines the Hungarian State Railway will, it is said, save 800,000 tons of coal yearly and reduce the consumption of coal to 1,500,000 tons. It is estimated that if all the railways are electrified there will be no need for Hungary to import coal.

Chilean Electrification Program

The first part of the Chilean State Railway to be electrified will include 116 miles of main line and 144 miles of track. The contract for equipment, as announced in the October issue of the *Railway Mechanical Engineer,* was awarded to the Westinghouse Electric International Company through its South American representatives, Errazuriz Simpson & Company, and amounts to a total of $7,000,000. This is the most important railroad electrification undertaken in 1921 and is the largest single order for electric traction equipment ever received in this country. The equipment will be designed according to American standards.

Disastrous Fire at Weehawkin, N. J.

The freight piers of the Erie Railroad, on the Hudson river, at Weehawken, N. J., about a half mile south of the West Shore Railroad passenger terminal, were damaged by fire on November 3 to the extent of about $2,000,000, the loss including 15 freight cars and great quantities of merchandise in the storehouses and in the cars. Of the seven piers at this place, only three are left standing. The fire started on pier D and this with piers A, B and C was destroyed with its contents; also a four-story brick warehouse. The freight destroyed consisted largely of oil, salt, lumber and flour. Eleven lighters and barges lying close to the piers were damaged, some of them badly.

Developments in the Railroad Labor Problem

There have been several significant developments in the railroad labor situation recently which indicate to some extent what may be expected in the near future. Foremost among these developments are: (1) the preparation of the railroads' case in favor of a further wage reduction averaging approximately 10 per cent and the steps which are being taken to bring this case before the Railroad Labor Board; (2) the presence of leaders of the engineers' and firemen's organizations "on the carpet" before their general chairmen at Chicago, explaining why and how the recent strike orders were recalled, and (3) the continued application of the Labor Board to the question of rules and working conditions.

Extent of Depression in Great Britain

The business depression in Great Britain as shown by traffic statistics of the railways, is severe. In July of this year passenger traffic, as shown by total passengers carried (exclusive of season ticket holders), had fallen 32.8 per cent from the figure for July, 1920, to a total of 101,450,975. Freight traffic declined 36.5 per cent to 1,088,443,125 ton-miles. Average receipts per ton-mile were 2.074 pence (about 4 cents). The average car load was 5.12 long tons and the average train load 123.52 long tons, as compared with 5.45 and 133 for the same period in 1920.

North Western Shop Employees Agree to Five-Day Week

The shop employees of the Chicago & North Western have agreed with officers of that carrier to accept a lay-off of one day each week in order to avoid a reduction in forces made necessary, according to the management, because of light business. The men were informed recently that a 10 per cent cut in the shop forces would be necessary and the men were offered an opportunity to choose between retaining a full force on a five-day per week basis or retaining 90 per cent of the force on a six-day per week basis. The employees voted to accept the five-day week.

St. Paul Makes Drastic Cut in Pay Roll

In order to keep within its allotment, all employees of the Chicago, Milwaukee & St. Paul, other than those engaged in actual operation, were placed on half time for the last two weeks of the present year. Officers of the road are not excepted in the economy order and, from the president down, will sacrifice one week's salary. In some of the departments the employees are working half time, while in other departments the plan is to work a week and then lay off a week. It is expected that the forces will be put back on a full time basis the first of the year but the order will not be revoked until business makes the full force necessary. Other cuts in forces or working hours have been made by the Louisville & Nashville, which has placed its shopmen on a five-day week basis, the Mobile & Ohio, the Southern, the Nashville, Chattanooga & St. Louis and the Baltimore & Ohio.

Director General Reports on Railroad Settlements

A comprehensive report on the status of the accounts of the Railroad Administration with reference to the settlement of the claims of the railroads growing out of Federal control was transmitted to the Senate on December 10 by Director General James C. Davis in response to a resolution adopted by the Senate on November 22 on motion of Senator La Follette. In this the amount due the carriers from the Government as of December 1 on accounts growing out of Federal control, including compensation, money taken over, maintenance, materials and supplies, depreciation and all other accounts, exclusive of additions and betterments, was estimated by the Railroad Administration at $750,670,589, while the railroads owed the Government a balance of $507,628,508 on account of additions and betterments undisposed of as of December 1, leaving a balance of cash required for final settlement, based on the estimate of the Railroad Administration and assuming that the balance due on additions and betterments would be collected by deduction from the indebtedness of the Government to the roads, of $243,042,080.

Clearing of Labor Board's Docket in Sight

The following announcement was made by the Railroad Labor Board on November 21:

"The Railroad Labor Board has disposed of exactly six times as many cases in the last few months as it did in the first period of its existence. The Board was organized in April, 1920. It disposed of 100 cases from April 15 to November 30, 1920. In the same period this year—April 15 to November 15, 1921—it disposed of exactly 600 cases. The round numbers, by an unusual coincidence, represent the actual number of cases carried through to a final decision.

"The increased number of cases disposed of indicates not only the greater rapidity of the Board's work but also how its volume has increased.

"With the recent disposal of 200 cases and the prospect that the new adjustment boards will handle a large amount of the grievance cases which have heretofore been brought before the Board, the clearing of the Board's docket may be said to be in sight."

"Labor" Contributes Some Additional Strike News

Labor, the newspaper published by the Plumb Plan League, reproduces in its latest issue a copy of an order said to have been sent by the Navy Department to all heads of departments and barracks petty officers under date of October 21, directing them to interview all men who come under their jurisdiction, with a view of finding out if any had previous experience in railroading; and to prepare lists showing the previous experience, such as fireman, engineer, trackman, switchman, round house and repair man, or in any duties in connection with railroad operation of all men assigned to each barracks or head of department.

The order also asked for a list of those who had had experience in machine gun crews and were good pistol or rifle shots. The lists were to be submitted to the executive officers on October 24.

The paper draws from this the inference that the Government had made extensive plans for resisting the strike of railroad employees which was called for October 30.

Markham Asks Employees to Repudiate Labor Propagandists

C. H. Markham, president of the Illinois Central, in an open letter, addressed to the employees of that road, asks for a showdown on charges made against the railroads by representatives of railroad employees.

He asks that either the employees back these accusations or repudiate them, and adds that if they know of any irregularities or mismanagement on the Illinois Central it is their duty to bring them to his attention.

The letter contains the names, dates and a resume of charges made by labor representatives such as Frank J. Warne, W. Jett Lauck and Glen E. Plumb. Mr. Markham says: "I cannot believe that these men, calling themselves your spokesmen, reflect the true sentiment of the men of the Illinois Central System, who have worked with the management so faithfully and wholeheartedly in building up a railway system which we pride ourselves in believing is one of the greatest railway systems in the world.

"But, frankly, I have been disappointed that these men have been permitted to continue to pour out unchecked torrents of false accusations without even a word of public protest from the men whom they claim to represent and whose money makes their activities possible."

Reopening of West Albany Shops

The New York Central has leased its repair shops at East Buffalo and at Toledo, as noted last month. No action has been taken toward opening the shops at Collingwood, Ohio.

The company has reopened the passenger car shops at West Albany, N. Y., a meeting of 616 employees having voted almost unanimously to accept the proposition of the company to resume work on a piece-work basis. These men evidently are convinced that they will do as well working directly for the company, or better, than if they were to go into the employ of a contractor. The employees have established a committee which is empowered to conduct any necessary negotiations with the superintendent of motive power.

It is understood that the piece-work rates will average about 25 per cent more than was paid, at piece-work rates, for similar work in 1917. These shops have been closed about 10 months.

Telephoning on Railroad Power Wires

On a trolley railroad near Schenectady, N. Y., on Thursday, December 1, the General Electric Company gave a demonstration of its "carrier current" system of communication by telephone over the propulsion wire of an electric railroad, conversation being held between different trains on the same track, and from trains to operators in stations and vice versa. A second current is superimposed on the trolley wire and the message is

conveyed to any desired distance, being picked up at any convenient point and made to energize a telephone instrument. The telephone current is generated at higher frequency than the power supply. Experiments in this line have been carried on by the General Electric Company for a number of years, and on the Chicago, Milwaukee & St. Paul electrified line communication has been carried on in this way for a distance of 60 miles.

Eight-Hour Day Abolished in South Africa

The Southern African Railways have abandoned the eight-hour day for certain classes of employees, according to the Railway Gazette (London). The railways have accumulated a deficit of some $15,543,791 since the fiscal year 1917-1918. The eight-hour day is estimated to cost some $4,860,000 annually. In lengthening the work-day the management endeavored to take into consideration the intensity and continuity of the work done. The employees affected and the length of the new work-day for them are enginemen and firemen, nine hours; ticket examiners and trainmen, ten hours. Overtime will be paid for at 1¼ rate. The duties of other employees will be considered and further adjustments made, but no hours will be increased beyond twelve, including times for meals, and where the work is exacting the present 48-hour week will be maintained.

Freight Car Loading

The number of cars loaded with revenue freight during the week ended November 12 showed a large drop, according to the weekly report of the Car Service Division of the American Railway Association, due largely to the effect of the Armistice Day holiday and election day in several states. The total was 753,046, as compared with 829,722 the week before, 927,586 in the corresponding week of 1920 and 808,304 in 1919.

Loading of revenue freight totaled 673,827 cars during the week which ended on November 26. This was 112,844 cars less than were loaded during the previous week, the decrease being due principally to the observance of Thanksgiving Day. The total, however, was 129,874 cars less than were loaded during the corresponding week in 1920 which also included the same holiday and 65,370 cars below the total for the corresponding week in 1919.

For the week ended December 3, 747,454 cars were loaded, an increase as compared with the previous week of 73,627 cars. For the corresponding weeks of 1920 and 1919 the loadings were 882,604 and 789,286 cars, respectively.

The report for the week ended December 10 showed loadings totaling 742,962 cars, or 4,528 cars less than reported for the week ended December 3. During the corresponding weeks of 1920 and 1919, 95,027 and and 19,014 cars less were loaded.

Locomotive Orders

The Central of New Jersey has ordered 25 Mikado type locomotives from the American Locomotive Company.

The Seaboard Air Line has ordered from the American Locomotive Company 10 Mountain type locomotives to have 27 by 28 in. cylinders and a total weight in working order of 315,000 lbs. and 15 Mikado type locomotives to have 27 by 30 in. cylinders and a total weight in working order of 284,000 lbs. All these locomotives will be equipped with superheaters.

Freight Car Orders

The Erie is building 70 caboose cars in its own shops at Buffalo, N. Y.

The Delaware, Lackawanna & Western has ordered 500 box cars from the American Car & Foundry Co.

The Live Poultry Transit Company, Chicago, has given a contract for 100 poultry cars to the American Car & Foundry Company.

The Pere Marquette has ordered from the Western Steel Car & Foundry Company, 500 box cars, with an option for 500 additional cars.

The Mathieson Alkali Works, Niagara Falls, N. Y., has ordered 20, 30-ton cars for handling tanks from the Standard Steel Car Company.

The Baltimore & Ohio has ordered 500 hopper car bodies from the Pressed Steel Car Company, and 500 from the Standard Steel Car Company, all to be of 55-ton capacity.

The Northern Pacific has ordered 1,200 steel center frame constructions from the Western Steel Car & Foundry Company. These are to be applied to box cars in the railroad company's shops.

Passenger Car Orders

The Philadelphia & Reading has ordered 30 coaches and 5 combination baggage and smoking cars from the Bethlehem Shipbuilding Corporation, Harlan Plant, and 15 coaches from the Standard Steel Car Company.

The New York, Ontario & Western has given an order to the Standard Steel Car Company for 20, 79-ft. coaches; 4, 70-ft. combination smoking and baggage cars; 3, 60-ft. baggage cars and 3, 60-ft. combination baggage and mail cars. These will be all steel cars, equipped with Commonwealth trucks.

Car Repair Contracts

The Chicago & Alton has awarded a contract for the repair of 150 gondola cars to the Streets Company, Chicago.

The Northern Pacific is having repairs made to a number of passenger cars at the shops of the Pullman Company.

The Union Pacific has awarded a contract for the repairs on 500 freight cars to the Pacific Car & Foundry Company, Seattle, Wash.

The Buffalo, Rochester & Pittsburgh has given a contract to the Buffalo Steel Car Company for the repair of 500, 50-ton hopper cars.

The Missouri Pacific has awarded a contract for the repair of 500, 30-ton box cars to the Sheffield Car & Equipment Company, Kansas City, Mo.

The Chicago, Burlington & Quincy has awarded a contract for the repair of 300 50-ton gondola cars to the General American Car Company, Chicago.

The Virginian Railway has given a contract to the Virginia Bridge & Iron Company, Roanoke, Va., for the repair of 1,500, 50 to 55-ton all steel coal cars.

The Chesapeake & Ohio has given contracts for the repair of 200 composite cars to the Ralston Steel Car Company, 500 steel cars to the Illinois Car & Manufacturing Company, Chicago Heights, Ill., and 300 composite cars to the American Car & Foundry Company's shops at Huntington, W. Va.

Shop Construction

Missouri Pacific.—This company has awarded a contract to Joseph E. Nelson & Sons, Chicago, for the construction of a pumping station and water treating plant at Fort Scott, Kan.

Chicago, Rock Island & Pacific.—This company has awarded a contract to T. S. Leake & Company, Chicago, for the construction of a car repair shed, 87 ft. by 200 ft., at Pratt, Kan., estimated to cost $20,000.

Air Brake Association to Hold Convention in Washington

At a meeting of the Executive Committee of the Air Brake Association held at the Hotel Sherman, Chicago, on December 13, it was unanimously voted to hold the regular annual convention of the association at the Hotel Washington, Washington, D. C., May 9, 10, 11 and 12, 1922. Accommodations will be provided in the new Ebbitt Hotel in the adjacent block for those who are unable to obtain rooms in the Hotel Washington, the headquarters of the association. All sessions will be held in the convention hall on the top floor of the Hotel Washington and all exhibits will be erected on the mezzanine floor of that hotel.

The officers of the association hope for a large attendance at the convention because of the necessity for educational work on matters pertaining to the air brake at this time. Many new men have been taken into railroad service during the war years and since who need air brake instruction and numerous air brake devices have been developed which remain to be explained to the older men and to those more recently employed.

MEETINGS AND CONVENTIONS

THE CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION OF AMERICA will meet in general session at the Great Northern Hotel, Chicago, Monday, January 9, at 9 a m., for the purpose of discussing and arriving at a uniform interpretation of the A. R. A. Mechanical Section 3 rules, effective January 1, 1922, and all other important business that may come up.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Annual convention May 9, 10, 11 and 12, Hotel Washington, Washington, D. C.

AMERICAN RAILWAY ASSOCIATION, DIVISION V—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next annual convention June 14 to 21, 1922, Atlantic City, N. J.

DIVISION V—EQUIPMENT PAINTING DIVISION.—V. R. Hawthorne, Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION VI.—PURCHASES AND STORES.—J. P. Murphy, N. Y. C., Collinwood, Ohio.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, 1145 E. Marquette Road, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa. Annual meeting Atlantic City, June, 1922.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio. Annual convention and exposition September 25 to 30, 1922, Detroit, Mich.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—W. A. Booth, 53 Rushbrook St., Montreal, Que. Regular meeting second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, New Morrison Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo. Meetings first Tuesday in month except June, July and August, at the American Hotel Annex, St. Louis, Mo.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Annual meeting January 12. Election of officers. Annual reports and paper by G. M. Basford.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill

CINCINNATI RAILWAY CLUB.—W. C. Cocder, Union Central Building, Cincinnati, Ohio. Meeting second Tuesday, February, May, September and November.

DIXIE AIR BRAKE CLUB.—E. F. O'Connor, 10 West Grace St., Richmond, Va.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 702 East Fifty-first St., Chicago, Ill. Next annual meeting May, 1922, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn.

MASTER BOILERMAKER ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York, N. Y. Next annual convention Hotel Sherman, Chicago, May 23 to 26, 1922.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Next meeting January 10. Paper on Test Department on Railroads will be presented by H. P. Haas, engineer of tests N. Y., N. H. & H.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgreb, 623 Brisbane Building, Buffalo, N. Y.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Meeting second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meetings fourth Thursday in each month, except June, July and August, at Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Next meeting January 13. Paper on Insights and Outlooks with special reference to railroad situation will be presented by Frank B. McMillin, vice-president and general manager of the Hydraulic Press Mfg. Co.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, Marine Trust building, Buffalo, N. Y.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 14 E. Jackson Boulevard, Chicago. Regular meetings third Monday in each month, except June, July and August.

PERSONAL MENTION

GENERAL

H. W. SALMON, JR., acting fuel agent of the Missouri Pacific, with headquarters at St. Louis, Mo., has been promoted to fuel agent.

D. C. MCALLISTER has been appointed assistant general air brake inspector of the Northern Pacific, with headquarters at St. Paul, Minn., succeeding E. L. Kenrick, who has resigned.

ORA S. JACKSON, whose appointment as assistant superintendent of motive power and machinery of the Union Pacific, with headquarters at Omaha, Neb., was announced in the December issue of the *Railway Mechanical Engineer*, was born at Huntington, Ind., on August 11, 1875. He entered railroad service as an apprentice machinist on the Erie, at Huntington, Ind., after which he worked as a roundhouse foreman and general foreman on the Cleveland, Cincinnati, Chicago & St. Louis for eight years. He then left that road to become general foreman and master mechanic of the Chicago, Indianapolis & Louisville, which position he held for five years, when he became superintendent of motive power of the Chicago, Terre Haute & Southeastern. After three years he was promoted to general superintendent in charge of the mechanical and operating departments, which position he held for five years up to the time of his recent appointment.

O. S. Jackson

G. W. LILLIE has been appointed superintendent of motive power of the Denver & Salt Lake, with headquarters at Denver, Colo. Mr. Lillie was born at Omaha, Neb., in 1868. He entered railroad service as an apprentice in the Omaha shops of the Union Pacific and was later promoted to draftsman. He became chief draftsman of the Oregon Short Line at Salt Lake City, Utah, in 1897. In 1899, he left railroad service to become mechanical draftsman for the United States naval construction base at Newport, Va. He re-entered the service of the Oregon Short Line in 1901 in the mechanical department. In 1907 he left to become supervisor of the car department of the St. Louis-San Francisco, with headquarters at St. Louis, Mo., and in 1908, he was promoted to superintendent of the Springfield shops with headquarters at Springfield, Mo. He again returned to the Oregon Short Line in 1910 as master mechanic with headquarters at Pocatello, Idaho. He left again in 1913, to become mechanical superintendent of the second district of the Chicago, Rock Island & Pacific, with headquarters at Topeka, Kan. In 1915 he entered the service of the Bingham & Garfield as master mechanic, with headquarters at Salt Lake City.

G. W. Lillie

G. J. Churchward, chief mechanical engineer of the Great Western Railway (England), will retire at the end of the present year, and C. B. Collett, the deputy chief mechanical engineer, will succeed him.

George M. Davidson, chemist and engineer of tests of the Chicago & North Western, with headquarters at Chicago, has been appointed industrial engineer, with the same headquarters. He will have general supervision of the laboratories, water supply, timber preservation, fuel consumption and other duties assigned to him by the president. H. D. Browne will succeed Mr. Davidson as engineer of tests.

G. H. Likret has been appointed fuel engineer of the Union Pacific with headquarters at Omaha, Nebr. B. E. O'Neill has been appointed fuel supervisor of the southern district with headquarters at Kansas City. A. L. Coey has been appointed fuel supervisor of the northern district with headquarters at Cheyenne, Wyo., and P. C. Coats has been appointed fuel inspector with headquarters at Omaha, Nebr.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

George Walker has been appointed road foreman of engines of the Atchison, Topeka & Santa Fe at Prescott, Ariz.

E. W. Lostrom has been appointed road foreman of engines of the Northern Pacific, with headquarters at Duluth, Minn., succeeding J. A. Marshall.

W. R. Harrison, master mechanic of the Atchison, Topeka & Santa Fe, with headquarters at Chanute, Kan., has been transferred to Argentine, Kan., succeeding E. E. Machovec.

W. H. Dempsey has been appointed assistant division master mechanic of the Chicago and Milwaukee division and the Milwaukee terminal of the Chicago, Milwaukee & St. Paul, with headquarters at Milwaukee, Wis., succeeding G. E. Passage.

S. G. Kennedy, general foreman of the Atlantic Coast Line at Lakeland, Fla., has been appointed master mechanic of the Tampa district with the same headquarters. Mr. Kennedy was born on May 29, 1876, at Kinston, N. C., and graduated from the North Carolina State College in 1897. In 1902 he became a machinist at the South Richmond shops of the Southern Railroad and later worked for the Pennsylvania, the Seaboard Air Line and Florida East Coast, beginning work with the Atlantic Coast Line at South Rocky Mount shops in 1906. He subsequently served as night foreman, day roundhouse foreman and machine shop foreman, and on July 22, 1918, was made general foreman at Lakeland.

S. G. Kennedy

W. N. Foster has been appointed master mechanic of the Iowa division of the Chicago, Milwaukee & St. Paul, with headquarters at Marion, Iowa, succeeding E. L. Notley, who has been assigned to other duties.

J. A. Marshall has been appointed acting master mechanic of the Lake Superior division of the Northern Pacific, with headquarters at Duluth, Minn., succeeding J. E. Goodman, who has been granted a leave of absence.

J. D. Young has been appointed acting master mechanic of the Central of New Jersey, with headquarters at Ashley, Pa., succeeding A. B. Enbody, who has been granted a leave of absence on account of ill health.

M. H. Haig has been appointed master mechanic of the Pecos division of the Atchison, Topeka & Santa Fe, with headquarters at Clovis, N. M., succeeding W. D. Hartley, who has been transferred to the New Mexico division.

L. E. Fletcher has been appointed acting master mechanic of the New Mexico division of the Atchison, Topeka & Santa Fe with headquarters at Raton, N. M., succeeding T. T. Ryan, who has been granted a leave of absence on account of illness.

G. E. Passage, assistant division master mechanic of the Chicago, Milwaukee & St. Paul, with headquarters at Milwaukee, Wis., has been promoted to master mechanic of the Terre Haute division, with headquarters at Terre Haute, Ind., succeeding J. A. Richards, who has been assigned to other duties.

C. E. Brooks, traveling engineer of the Chicago, Milwaukee & St. Paul, with headquarters at Miles City, Mont., has been promoted to master mechanic of the Bellingham division, with headquarters at Bellingham, Wash., succeeding C. E. Cessford, assigned to other duties on account of ill health. W. M. Anderson has been appointed master mechanic of the Northern Montana division, with headquarters at Lewistown, Mont., succeeding O. A. Coltrin, who has been assigned to other duties.

SHOP AND ENGINEHOUSE

W. A. Rocksberry has been appointed boiler foreman of the Chicago, Rock Island & Pacific at Eldorado, Ark.

P. C. Feick, formerly general foreman of the Frisco at Oklahoma City and other points, is now employed as district foreman of the Oregon Short Line at Nampa, Idaho.

W. A. Worely has been appointed roundhouse foreman on the Arkansas-Louisiana division of the Chicago, Rock Island & Pacific, at Winnfield, La., succeeding J. H. Kelley, who has been assigned to other duties.

PURCHASING AND STORES

S. J. DeGraeff has been appointed storekeeper of the Southern Pacific of Mexico with headquarters at Empalme, Sonora, Mexico.

G. W. Hanegan, storekeeper of the central and western divisions of the Minneapolis & St. Louis, with headquarters at Minneapolis, Minn., has been promoted to general storekeeper, with the same headquarters.

B. W. Griffith, district storekeeper of the New York Central, lines west, with headquarters at Collinwood, Ohio, has been promoted to assistant general storekeeper, with the same headquarters, and will be succeeded by F. J. McMahon. A. L. Prentice, division storekeeper, with headquarters at Elkhart, Ind., has been promoted to assistant general storekeeper, with headquarters at Collinwood, and he will be succeeded by C. F. Heidenreich.

OBITUARY

Axel S. Vogt, formerly mechanical engineer of the Pennsylvania, Eastern lines, died on November 11 of heart disease. Mr. Vogt was born on January 19, 1849, at Christianstad, Sweden, and was educated in the public schools. He began railway work in June, 1874, with the Pennsylvania at Altoona and remained with that road until 1882, when he went with Schutte & Koehrting, Philadelphia, Pa. In November, 1883, he returned to the service of the Pennsylvania as assistant engineer of tests. On March 1, 1887, he was promoted to mechanical engineer, and remained in that position until February 1, 1919, when he retired. Since his retirement he was connected with the Baldwin Locomotive Works for a short time in an advisory capacity.

Axel S. Vogt

W. P. Hawkins, formerly fuel agent of the Missouri Pacific and for four years president of the Western Coal & Mining Company, died on November 23, at St. Louis, Mo.

SUPPLY TRADE NOTES

Arthur P. Bowen has been elected assistant to the vice-president of the Ryan Car Company, Chicago.

The Rich Tool Company, Chicago, has appointed the Busch Corporation of St. Louis, Mo., its representative in the St. Louis territory.

The Osgood Company, Marion, Ohio, has opened a branch sales office at 1211 Conway building, Chicago, in charge of Arthur B. Sonneborn, as manager.

J. F. Kelly, Jr., has been appointed export sales manager of the Electric Storage Battery Company, Philadelphia, Pa. Mr. Kelly will have his headquarters at 23 West Forty-second street, New York City. He joined the Electric Storage Battery Company in 1909 and has been in the service of this company continuously except during the period of time he spent in military service. He was commissioned a captain in the United States army in November, 1917, at the Plattsburg Training Camp and was assigned for duty as officer in charge at the army supply base, at Port Newark, N. J., serving until his release in January, 1919. Mr. Kelly has spent considerable time with officers of the railroads in Australia, Argentina and Brazil, having recently returned from a two years' trip around the world in the interests of the Electric Storage Battery Company.

J. F. Kelly, Jr.

The F. C. Richmond Machinery Company, 117 West Second street, Salt Lake City, Utah, has been appointed representative of the Orton & Steinbrenner Company, Chicago.

R. W. Levenhagen, vice-president of the Glidden Company, Cleveland, Ohio, has recently assumed direct charge of the sales policies and sales activities of the Glidden organization.

The Combustion Engineering Corporation, New York, has opened a new branch office at 806 First National Bank building, Pittsburgh, Pa., in charge of W. C. Stripe, formerly manager of the Philadelphia office.

The Enterprise Railway Equipment Company, Chicago, has purchased all patents and trade mark "Ingoldsby" of the Ingoldsby Automatic Car Company, a corporation organized under the laws of the State of West Virginia.

Andrew Fletcher, president of the American Locomotive Company, has been elected a director of the American Car & Foundry Company to fill the vacancy on the board caused by the resignation some time ago of Walter G. Oakman.

Gerald Kochenderfer, formerly district representative at Indianapolis, Ind., has been appointed district sales manager of the Warner & Swasey Company, Cleveland, Ohio, with headquarters at Chicago, succeeding H. E. Whitham, resigned.

The Combustion Engineering Corporation, New York, recently opened two branch offices, one at 216 Latta Arcade, Charlotte, N. C., in charge of T. E. Nott and the other at Seattle, Wash., where the company is represented by the Fryer-Barker Company, 1133 Henry building.

The merger of the Haskell & Barker Car Company, Inc., with the Pullman Company, was approved by the stockholders of the Pullman Company at Chicago, on December 20. The directors have been increased from nine to twelve by the election of Edward F. Carry, president of the Haskell & Barker Car Company; John R. Morrow, and Arthur O. Choate.

Manning, Maxwell & Moore, Inc., New York, has removed its Philadelphia, Pa., office from the Lincoln building, to larger quarters in the Pennsylvania building at Fifteenth and Chestnut streets. The company has also removed its Boston, Mass., office from 10 High street to the Textile building, 99 Chauncey street.

Fred Atwater, vice-president and treasurer of the Columbia Nut & Bolt Company, Inc., Bridgeport, Conn., was on November 8 elected mayor of the city of Bridgeport by the largest majority ever given any candidate. Mayor Atwater will still retain his connection with the Columbia Bolt & Nut Company, Inc., with which company he has been associated since 1902.

Charles F. Smith has been elected chairman of the board of directors of the New Britain Machine Company, New Britain, Conn., succeeding F. G. Platt, who resigned on account of ill health. Mr. Smith is chairman of the board of directors of Landers, Frary & Clark, New Britain, and was formerly chairman of the board of the American Hardware Corporation.

The Greenfield Tap & Die Corporation, Greenfield, Mass., has consolidated its small tool and drill divisions. P. T. Irvin, formerly manager of its drill division, is in charge of the consolidation, which will be called the small tool division. Mr. Irvin has for the past three years been sales manager of the Lincoln Twist Drill Company and prior to that was sales manager of Wells Brothers Company, Greenfield.

The Cincinnati Shaper Company and its subsidiary, the Cincinnati Gear Cutting Machine Company, have arranged for a branch sales office in Indianapolis, Ind., with headquarters at 940 Lemcke annex. T. C. McDonald, who has been appointed local representative at Indianapolis, will cover the Indianapolis and Louisville districts, also certain states in the southwest, and will continue as local representative of the Reed-Prentice Company.

B. E. D. Stafford, general manager of the Flannery Bolt Company, Pittsburgh, Pa., died on November 30, at Atlantic City, N. J. Mr. Stafford was born in 1866 in Brooklyn, N. Y., and was educated in the public and night schools. At the age of 15 he took up patent office drawing and soon became an expert penman. In order to better himself for mechanical drawing he acquired a practical knowledge of the machine, tool and screw making trades and within a few years ranked as one of the few expert operators in America of the universal type of milling machine and the automatic screw machine. At the age of 21 he was made foreman of the tool shop of a large manufacturer of cotton machinery at Hopedale, Mass., and built most of the automatic machinery for the plant. Later he became a specialist in reducing shop costs and in 1895 was engaged by B. M. Jones & Co. to demonstrate the uses of self-hardening steels. Five years later he was employed as a staybolt salesman by the Ewald Iron Company. In the fall of 1904, Mr. Stafford was engaged by the Flannery Bolt Company to develop and market the Tate flexible staybolt for locomotive firebox service. During the time he has been identified with that concern, Mr. Stafford has done much to advance the methods of locomotive firebox construction. Mr. Stafford lived in Millville, N. J., and funeral services and burial were in Vineland on the morning of December 3.

B. E. D. Stafford

Anton Becker, for 15 years connected in official capacities with The Ralston Steel Car Company, Columbus, Ohio, has resigned to enter the railroad supply business. He has organized The

Becker Sales Company, with office in the Union Central building, Cincinnati, Ohio. In connection with railroad specialties The Becker Sales Company will also have the sales representation of The Ralston Steel Car Company, in certain territory in middle western states.

John L. Artmaier, eastern sales manager of the Buda Company, in charge of the New York office, has been appointed sales manager of the railroad department of the company, with headquarters in the Railway Exchange building, Chicago. J. E. Murray, formerly assistant to Mr. Artmaier, has been appointed eastern sales manager and J. H. Maher, formerly representing the company at Buenos Aires, Argentine, has been appointed eastern export manager.

The Richardson-Phenix Company, Milwaukee, Wis., and the S. F. Bowser & Co., Inc., Fort Wayne, Ind., have consolidated and will henceforth be known as the S. F. Bowser & Co., Inc., with headquarters at Fort Wayne. The filtration and lubrication appliance business of both companies will be conducted by the Richardson-Phenix division, S. F. Bowser & Co., Inc. J. William Peterson, president of the Richardson-Phenix Company, will assume the office of vice-president of the S. F. Bowser & Co., Inc., and will be in charge of the Richardson-Phenix division.

Clarence E. Rood, sales manager of the Gould Coupler Company, New York, died on December 11 after a brief illness, at his home at the Algonquin Hotel, New York City. Mr. Rood was born in Erie, Pa., and early in his career was general manager of the American Express Company in St. Louis, Mo. Later he went to Buffalo where for a time he was a member of Rood & Brown, car wheel builders. He subsequently owned and operated the Rood Malleable Iron Company, Lancaster, N. Y. About 12 years ago he entered the service of the Gould Coupler Company as a representative at New York and at the time of his death was sales manager of that company.

F. N. Bard, vice-president and treasurer of the Barco Manufacturing Company, Chicago, has been elected president, succeeding George M. Bard, who has been elected chairman of the board of directors. C. L. Mellor, sales manager, succeeds F. N. Bard as vice-president and will also act as secretary, F. N. Bard retaining his duties as treasurer. Frank H. Stiles, formerly mechanical representative at Boston, Mass., has been appointed district sales manager with the same headquarters. Mr. Stiles, previous to entering the service of the Barco company, was with the New York, New Haven & Hartford. Arthur S. Lewis, mechanical representative at New York, has been appointed district sales manager with the same headquarters.

The Whiting Corporation, Harvey, Ill., has bought a controlling interest in the Grindle Fuel Equipment Company, manufacturers of complete powdered coal plants, for use in connection with malleable furnaces, annealing ovens, steam boilers, billet heating and various other types of furnaces. The Grindle Fuel Equipment Company has moved its offices to Harvey, and will continue its business under the same name. Whiting Corporation will manufacture all Grindle equipment. The officers are as follows: B. H. Whiting, president; T. S. Hammond, secretary and treasurer and A. J. Grindle, vice-president and general manager; and the board of directors includes the above officers and J. H. Whiting, R. H. Bourne, N. S. Lawrence and A. H. McDougall.

John W. Duntley, one of the founders of the Chicago Pneumatic Tool Company and from 1895 to 1909 president of that concern, was killed by an automobile truck at Chicago on December 15. Mr. Duntley was born at Wyandotte, Mich., on August 16, 1863, and entered business as a foundryman in 1878. From 1884 to 1895 he was engaged in the railway supply business and upon the latter date he organized the Chicago Pneumatic Tool Company. From this date to 1909 he was engaged in expanding this organization, enlarging the scope of the business at the same time by absorption and amalgamation both in this country and abroad. In 1909 he organized and became president of the Duntley Manufacturing Company, manufacturers of the pneumatic cleaners. Of late years he devoted his energy to the Duntley Automobile Accessory Company, Chicago, of which he was president. He was also president of the Libertad Mining & Smelting Company. In 1900, he was decorated with the cross of the Legion of Honor by the president of France.

TRADE PUBLICATIONS

Pumps.—The Oilgear Company, Milwaukee, Wis., has recently issued Bulletin No. 6 fully describing and illustrating its hydraulic control pump which may be connected to any device requiring oil under pressure.

Condenser Coils.—A small folder illustrating and briefly outlining the advantages of Elesco condenser coils for refrigerating and ice making plants has recently been issued by the Superheater Company, New York.

Drills.—The Hisey-Wolf Machine Company, Cincinnati, Ohio, has recently issued a four-page bulletin, No. 105-A, describing and featuring in a full sectional drawing the interesting features of construction of its new super-universal motor drills.

Grinding.—Descriptions and illustrations of typical work done on its grinders, also a partial list of users and a list of parts ground, are contained in the interesting data book of 63 pages which the Blanchard Machine Company, Cambridge, Mass., has recently issued.

Pipe Installation Costs.—The A. M. Byers Company, Pittsburgh, Pa., has recently issued a four-page folder calling attention to Bulletin No. 38 entitled "The Installation Cost of Pipe." Cost analyses of 20 different pipe system installations are printed in this bulletin which contains 32 pages, 8½ in. by 11 in.

Boring, Drilling and Milling Machine.—The Pawling & Harnischfeger Company, Milwaukee, Wis., has issued Bulletin 4F describing and illustrating its new horizontal boring, drilling and milling machine. One of the interesting illustrations included in this bulletin shows how compactly and conveniently all operating levers are concentrated on the saddle.

Tractor Cranes.—The Industrial Works, Bay City, Mich., has issued Catalogue No. 113 illustrating and describing its type BC crawling tractor crane of 20,000 lb. capacity, which is adapted to the needs of road contractors, lumber and coal dealers, gravel, sand and stone producers, foundries, railroad reclamation and storage yards, and moderate-size manufacturing plants.

Turbine Generator Units.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued Circular 1094-B, describing and illustrating its turbine generator units. Reaction and impulse types of turbines, both the semi-double flow type and the multiple cylinder type, are discussed in this circular. Bleeder turbines and gear turbines are described, and each part of the turbine is given detailed consideration. The generator is also discussed and illustrations are given to show the latest types of construction.

Tube Facts.—The manufacture of condenser tubes at the works of the Scovill Manufacturing Company, Waterbury, Conn., is taken up in detail in a booklet recently issued by this company. Season cracking and corrosion are the two principal causes of failure of condenser tubes. In the Scovill laboratories investigations are being carried on continually to determine and eliminate causes of weakness in the structure of the metal. Modern manufacturing processes to a great extent eliminate many of the defects. Production of seamless tubing by both the drawing and cupping processes is outlined, as well as the production of Scovill Admiralty tubes. Special alloys, as bronze, nickel silver, naval brass, etc., are made into Scovill tubing, as well as the condenser work.

Oil and Stationary Steam Engines.—Two neatly and attractively arranged educational booklets entitled "Oil Engines" and "Stationary Steam Engines," both of which contain numerous illustrations, the principal features of which are brought out in various colors, have recently been issued by the Vacuum Oil Company, New York. In the first booklet the construction and operation of surface ignition oil engines and other data pertaining to classification, field of service, methods of lubrication, etc., are taken up in a thorough and interesting manner. The second booklet on the subject of stationary steam engines is divided into two parts and treats of the classification of reciprocating steam engines, factors of steam engine operation, mechanical principles, lubrication, etc.; also boiler plant and steam production.